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Exploring Student's Interdisciplinary Contributions to More Sustainable Solutions in the Built Environment and Infrastructure Design

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RESUMEN

Los desafíos del mundo actual requieren soluciones complejas a partir de desarrollos multifacéticos e interdisciplinarios. Existen importantes investigaciones que sustentan la idea de que el mundo contemporáneo se sostiene sobre la interacción de diferentes campos del saber. De igual forma, el mayor impacto en soluciones y desarrollos está directamente relacionado con el nivel de interdisciplinariedad del equipo desarrollador. Este artículo analiza las prácticas interdisciplinarias actuales en la educación en ingeniería a través de un estudio de caso exitoso. Específicamente, investigamos a un equipo de estudiantes que participó en un concurso mundial de concreto y cuya propuesta de solución obtuvo el primer lugar. Los miembros de dichos equipos provenían de diferentes orígenes, áreas de especialización y niveles de conocimiento. Este estudio exploratorio preliminar utiliza un análisis de contenido de las características de la solución presentada por los estudiantes para identificar rasgos de sostenibilidad y su conexión multidisciplinar. Los resultados sugieren que las interacciones en equipos interdisciplinarios promueven diseños que maximicen soluciones eficientes. Los autores establecieron el camino para el trabajo futuro al realizar entrevistas y grupos focales con los miembros del equipo de estudiantes y los instructores asesores para comprender las contribuciones diferenciadas de cada miembro y sus características. Los autores reflexionan sobre el camino que podría tomar la academia para formar nuevos enfoques pedagógicos que incluyan la interdisciplinariedad en las escuelas de ingeniería.

Palabras clave: Equipo interdisciplinario, interdisciplinariedad, soluciones sotenibles, objetivos de desarrollo sostenibles, interdisciplinariedad en ingeniería, educación en ingeniería.

ABSTRACT

Current world challenges require complex solutions from multifaceted and interdisciplinary developments. There is significant research that supports the idea that the contemporary world stands on the interaction of different fields of knowledge. Similarly, the higher impact on solutions and developments is directly related to the level of interdisciplinarity of the developing team. This paper looks at current interdisciplinary practices in engineering education through a successful case study. Specifically, we investigated a student team that participated in a worldwide concrete contest and whose proposed solution obtained first place. The members of such teams came from different backgrounds, areas of expertise, and levels of knowledge. This preliminary exploratory study uses a content analysis of the characteristics in the solution presented by the students to identify sustainability traits and their multidisciplinary connection. The results suggest that interactions in interdisciplinary teams promote designs that maximize efficient solutions. The authors set up the path for future work to conduct interviews and focus groups with the members of the student team and the advising instructors to understand the differentiated contributions of each member and their characteristics. The authors reflect on the avenue that academia could take to form new pedagogical approaches that include interdisciplinarity in engineering schools.

Key words: Interdisciplinary team, interdisciplinarity, sustainable solutions, sustainable development goals, interdisciplinary in engineering, education in engineering.

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INTRODUCTION

The world's challenges require complex and novel solutions from multifaceted and interdisciplinary developments in the modern and global landscape. The interaction of different fields of knowledge breaks the "boundaries of a single academic discipline or methodological approach" [1] , bringing innovative and sustainable results to address current and future challenges. Therefore, multifaceted and interdisciplinary activities contribute to students in the built environment and infrastructure development majors to develop more sustainable solutions.

Specifically, interdisciplinarity is about applying knowledge and skills across multiple disciplines to address problems through multiple lenses [2]. This means that interdisciplinary creations require an overarching view that comes from the collaboration of various sources of disciplines and professionals [3]–[5]. Consequently, the transcendence of multifaceted and interdisciplinary contributions has created a new form of knowledge-sharing between professionals in different areas [1]. In education, such knowledge-sharing generates a positive impact on students' skills.

Applied multifaceted and interdisciplinary practices in education improve the development of engineering design and solutions [6], [7]. The combination of knowledge generates an analytical environment to tackle problems and questions that cross traditional disciplinary boundaries [8]. Precisely, in engineering, the interdisciplinary knowledge from professionals in other disciplines allows the construction of creative, innovative, efficient, and sustainable structures [9], [10]. For the case study in this paper, the design ideas and processes, such as textile-reinforced concrete, were born from interdisciplinary contributions, which can be applied to today's global social and environmental problems.

Finally, this paper aims to study the multifaceted and interdisciplinary practices in engineering education through a successful case study. The case of study is the proposed solution by an interdisciplinary team of students that participated in a worldwide concrete contest by the American Concrete Institute (ACI). The members of the team came from different disciplines and levels of expertise to enhance the combination of knowledge and experience in the learning process. The authors analyzed the sustainability traits of the team's proposed solution and the fields of knowledge that support such characteristics. Hence, this study aims to understand the role of interdisciplinary solutions for the built environment and infrastructure development majors.

DEVELOPMENT FO THE TOPIC

Background

Today's worldwide challenges require innovative and sustainable solutions to change the way of living. These solutions do not arise based on one discipline only [2], [11]. On the contrary, they need complex solutions from multifaceted and interdisciplinary developments. Specifically, interdisciplinarity employs multiple academic fields of knowledge to create a comprehensive understanding [12]. This means that multifaceted and interdisciplinarity teams apply knowledge and skills across multiple disciplines to create complex and creative solutions [1]. Therefore, introducing interdisciplinary practices allows students and professionals to make connections between several kinds of knowledge to use them to solve current global challenges.

One of the advantages of interdisciplinary studies is that it can reinvent the entire education process and create new solutions. By allowing students and professionals to cross traditional boundaries and disciplines, new contributions and connections are forged against the world's problems and beyond [13]. In this way, students and professionals can combine multiple kinds of knowledge and pursue different ways of thinking about the same problem or subject [14]. For that reason, this encourages cross-disciplinary collaboration that allows the development of critical thinking skills to find creative solutions to the real world. On the other hand, the benefits of multifaceted and interdisciplinary studies can be technically summarized into five categories [1]. The first one is related to providing sustainable solutions to crucial problems. The second one refers to improving current research troubles from the base. The third one is about providing stimulus to a specific discipline area. The fourth one talks about the importance of challenging modern knowledge and understanding the real world. Finally, the last benefit is promoting the development of new methodical approaches [15].

However, interdisciplinary studies and collaborations have significant challenges that should be considered. One of the biggest barriers to obtaining true interdisciplinary contributions in education is the necessity for collaboration of educators [16]. The lack of communication between students, professors, and advisors prevents the shifting of disciplines, which causes the adaptation of interdisciplinarity to be difficult. Traditional learning processes are based on the idea of "common core"—students working for the same goal, taking similar courses, and therefore, exchanging analogous ideas [14]. This could cause students to perceive interdisciplinarity as an unimportant characteristic of engineering and, therefore, to apply it less frequently or just to check a box.

In addition, another big challenge of applying interdisciplinarity in education is that the knowledge is antagonistic between professionals or students respectively [17]. This difference prevents achieving true integration of disciplines and knowledge as well, but more importantly, this puts a barrier between disciplines with totally different areas of knowledge. Therefore, the integration of different disciplines requires areas of knowledge that relate to and complement each other, to ensure that the combination of knowledge is effective and generates an adequate solution [18]. In this way, interdisciplinarity in related academic fields serves to create an academic or organizational community with students or professionals committed and with a sense of belonging.

Relationship between interdisciplinarity, sustainable solutions, and education.

Besides interdisciplinarity having benefits and barriers, it is closely related to sustainability. In September 2015 the United Nations acknowledged the need for a more sustainable world, setting 17 Sustainable Development Goals (SDGs) [19]. In general, the 17 SDGs have the goal of “ending extreme poverty, protecting the planet, and ensuring prosperity for all by 2030” [20]. The SDGs also include issues such as climate change, sustainable consumption, and most importantly sustainable development, concluding that quality education is the best way to promote it [21]. For this reason, the fourth SDG focuses specifically on “education for sustainable development” [20], which evidences the importance of the education process in sustainable solutions.

Sustainable development needs several disciplines, such as science, environment, engineering, medicine, architecture, history, economics, and so on. For this reason, the SDGs need an interdisciplinary approach to be pursued [22]. By applying interdisciplinarity in education, students will be able to confront “problems that cross traditional disciplines, involve multiple stakeholders, and occur on multiple scales” [23], such as climate change. Interdisciplinarity must prepare students and professionals to find appropriate solutions to current challenges and take action to address them, achieving “its purpose by transforming the society” [21].

In this way, interdisciplinary collaborations allow the exchange of ideas between professionals and students with diverse backgrounds, areas of expertise, and levels of knowledge, also having a positive impact on built environment infrastructure. Additionally, interdisciplinary developments challenge the personal and institutional boundaries “acting to maintain a sense of ownership and authority over territories of knowledge” [1]. This creates a methodical and unified academic and work environment in which students and professionals acquire more knowledge.

Promoting sustainable development is the new urgency in the context of climate change and biodiversity loss [24]. Industrialization and the high consumption of resources demand that all human activities have a sustainable approach. Sustainability can be implemented through ideas, designs, prototypes, models, etc. that involve several fields. In other words, sustainability must be applied through interdisciplinary solutions. These solutions are characterized by creativity, innovation, efficiency, and, in most cases, low cost [25]–[27]. Green buildings implement sustainability using “renewable energy sources, sustainable and recycled materials, quality of the environment, people’s health and comfort, ecological waste management, transport, and many other parameters” [28] to improve the health of tourists and, most importantly, promote sustainable solutions.

Green Hotels is a good example of applying interdisciplinary education to create sustainable solutions because it requires a combination of interrelated disciplines. However, interdisciplinarity is difficult to implement in academia because it demands restructuring the teacher training process so that teachers understand the interconnectedness between disciplines and their importance [22]. Despite that, interdisciplinary cooperation is considered an important element in higher education because it can instill creativity, innovation, and synergy through collaboration, teamwork, application, and blurring of disciplinary boundaries [29]. Thus, in this paper we explore the interdisciplinary contributions in related construction-related academic fields to study how interdisciplinarity is working and adapting in education nowadays.

There are some important variables to develop an interdisciplinary education, such as selecting the problem to solve, determining how much interaction it takes between the different disciplines, and the constructive alignment [30]. Nevertheless, it has been stated that it is difficult to make significant progress in the interdisciplinary education field in the absence of defined disciplines for the participants [31]. Also, other significant aspects such as pedagogy, epistemology, and politics are present in these interdisciplinary investigations [32]. It is important to remember that in an interdisciplinary team, there should not be any hierarchy between the participative disciplines, but respect and mutual contribution to generate more results, approaches, and new questions to be answered [30]. The simple fact of juxtaposing a professor within a university class does not conceive the idea of developing understood and complex thinking [32]. This is why interdisciplinary education within universities is a purely expository and demonstrative environment, so the urgency of interdisciplinary action in education needs to be given by teachers based on its theoretical purposes [32].

There are no specific models to apply interdisciplinarity in education, although it is the key to employability and sustainable development [33]. Problem-based learning (PBL) and project-based learning (PjBL) seem suitable to enhance students' interdisciplinary competence because both pedagogies empathize with student collaboration from other disciplines [33]. The difference between these pedagogies is that PBL focus their learning mode to allow students to focus their academic projects to their context, expectations, interests and knowledge, and PjBL focuses their learning mode to activities and tasks where students, through a process of negotiation, look for the main objective which is to obtain a final product or solution[30].

Research objective

This paper aims to explore the contributions to sustainability solutions by an interdisciplinary team of students from construction-related majors. This article explores the sustainable characteristics of a solution proposed by an interdisciplinary team of students in a worldwide concrete contest.

Methodology

The study uses a case study methodology [34], [35] to explore how interdisciplinary teams contribute to sustainable designs. The researchers analyzed the solution proposed by students for the yearly worldwide concrete contest hosted by the American Concrete Institute. The solution was presented in a 7-minute video showcasing a solution proposed by students (link: https://www.youtube.com/watch?v=mNdnRN-99Bs). The case study Unit of Analysis consisted of the students' design solutions for the contest. Based on the theory previously described, the propositions of the case study are: (i) solutions proposed by students from different fields will be reflected in the characteristics of such solution, and (ii) solutions proposed by students from interdisciplinary teams in the construction major will have sustainability traits such as innovation, creativity, low cost, and user-focused solutions.

The ACI competition aims to seek and find creative and innovative ideas to advance the concrete industry. This year, the challenge was to propose the future of concrete in building societies of the future. There were two categories: most innovative design/developmental use of concrete, and overall highest score. Each category was evaluated for a video submission proposing each solution (60%) and an interview (40%). The interview only occurred with the teams who received higher scores in the solution presented in the video. The judges were appointed by the ACI chair of committee S801, who develop the scoring rubric for the contest.

Team selection and students' work.

The team selection aimed to gather an interdisciplinary group. Professors of civil engineering revised student applications and selected a team made up of six members: three junior/senior civil engineering students, one architect, one graphic designer and animator, and one economics student who knew sign language. The team also included a faculty coordinator and a board of faculty consultants to meet once a week. The team had only three weeks to prepare their solution, starting from brainstorm to submitting their final product. The team advisor oversaw and supported the work of students to allow for different perspectives and approaches that maximized the students' strengths. Civil engineering students were interested in doing research about new ideas of concrete, and the architecture student helped them to think out of the box to improve the ideas with new perspectives. The economics student brought feasibility and psychological traits to the table. The graphic design student helped them to be more creative and to improve communication of science to not-so-technical language. Finally, sign language was included, as the students' initiative, to create an inclusive video.

To carry out an interdisciplinary process, the advisor used focus group discussion methodology that consisted of creating three groups from the team, with students participating in more than one group. The first group researched innovative ideas of concrete. This group began by creating brainstorming meetings with the advisor to discuss the ideas. Each idea was analyzed by civil engineering and architecture students. The second group investigated economic and environmental impacts. The third group investigated impacts of COVID-19 on mental health and quality of life in the cities, and its relationship with the potential solutions. Each focus group had meetings with the graphic design student to support the preparation of the video, ensuring that the elaborated sketches aligned with the script. In the drawing and writing processes, all of students were able to elaborate ideas concerning their script.

Students' proposed solution.

The final solution crafted by the team consisted of using optical fibers within the Autoclaved Aerated Concrete (AAC) to make translucid masonry blocks and highlighting the multifaceted benefits of such materials and indoor exposure to natural sunlight. Students researched translucent concrete and AAC from academic committees, manufacturers, and producers of translucent concrete, the transportation logistics, and the construction methods and technologies. The characteristics of the final solutions included the benefits of natural light such as the psychological effects on users, improved green building standards, reduced costs of production and commercialization, low-energy manufacturing material, improved structure by reducing dead weight, and connections to Heating, Ventilation, and Air Conditioning (HVAC) systems. The solution included sign language translation to be more inclusive.

Data analysis.

For data analysis, the characteristics of the solutions presented by the teams were established. Following previously developed coding methods [36], [37], the solution was transcribed and coded for similar ideas and then clustered in emerging codes and a priori codes such as innovative, creative, efficient, low-cost, and user-focused and SDGs-oriented characteristics. The codes were clustered around overarching themes contrasting the sustainability traits with the knowledge of origin to understand how interdisciplinarity worked among the team. The authors acted as Coders 1, 2, and 3, having an 88% of agreement in the coding. The average percent agreement was determined by the sum of a discrepancy between the coders and the number of times an additional coder suggested another category for a particular element. Discrepancies were then discussed and resolved.

Results

The results presented below reflect the sustainable characteristics of the solution presented by the interdisciplinary team. The solution's characteristics were clustered into low-cost, creative/innovative, user-centered, and SDGs-centered solutions.

Sustainable solution: Low-cost.

As a first sustainable solution, low-cost has the objective of improving and taking advantage of the available materials in the market, looking for a better application for them and avoiding wasting money on the common and traditional. The solution states that carrying out masonry with optical fibers through Autoclaved Aerated Concrete is profitable, stated at minute 01'46''.

This AAC consists in its composition of fine aggregates, cement, water, and an expansion agent, which gives it the ability to expand by itself. Some advantages for the client who will use a structure with AAC are that masonry will preserve temperature, have fire prevention and natural porosity that works as an acoustic insulation, be moisture-proof, provide environmental protection, and others. Also, the physical properties of AAC benefit builders and masons, since its porous structure makes it easy to move as well as modify with cuts or drilling, which will also save in workforce.

Minute	**Sustainable Solution**	**Reason**	**Student Area Contribution**
01'46"	Low-cost	Autoclaved Aerated Concrete (AAC)	Civil Engineering
05'26"	Low-cost	Optimization of energy performance	Architecture / Economic

Table 1. Low-cost as sustainable solution noticed in video. Author's work (2022).

Sustainable solution: Creative / Innovative.

The second sustainable solution is presented as the creativity and innovation of the participants in the face of a problem, with a different solution. The video's introduction starts by discussing the psychological benefits that occur in a user of a structure from the first rays of daylight. From minute 01'23" onwards, the use of optical fibers is mentioned not only within traditional concrete but rather with AAC. The benefits of such an idea relate directly to improving the user's mood and performance. Although the part of making translucent concrete is innovative, mixing different topics of construction makes it a creative idea, thus helping to provide a creative/innovative solution in terms of economic, psychological, constructive, or architectural traits.

Minute	Sustainable Solution	Reason	Student Area Contribution
01'23"	Creative / Innovative	Use of optical fibers into traditional concrete mix	Civil Engineering
01'29"	Creative / Innovative	Translucent concrete blocks for masonry	Architecture
02'01"	Creative / Innovative	Introduce optical fibers into AAC mix	Civil Engineering
02'22"	Creative / Innovative	Translucent AAC masonry units	Architecture / Civil Engineering

Table 2. Creative/Innovative as sustainable solution noticed in video. Author's work (2022).

Sustainable solution: User-centered.

Although the ACI competition is a technical contest, the students' winning solution focuses first on the user. The proposed solution begins by focusing on the cognitive benefits of users from the translucent masonry of the AAC, knowing that the higher the content of fibers in the blocks the higher the amount of light it allows. At minute 03'08", the team states the importance of considering the environment that the clients/users want. The passage of a greater amount of natural light leads to an improvement of the state of mind and health, but it can also increase temperatures, preferences for which differ for designing a home or an office. Other preferences for users to consider are the potential decorative traits and the amount of indoor light desired. At minute 06'06", the team mentions that if users spend a third of their lives locked up in an office, using translucid masonry can help change the indoors experience. Furthermore, the video states that although optical fibers within masonry blocks may be costly, the costs drop when using AAC. Finally, when translucent masonry is a replacement for traditional masonry, people will receive natural light, which will increase their well-being by 70%. Also, with translucent blocks, it will no longer be necessary to use too much electric lighting or systems belonging to the HVAC, since the lighting and mechanical properties of the block will avoid wasting energy, so the electric bill will be reduced considerably.

Minute	Sustainable Solution	Reason	Student Area Contribution
03'08"	User-Focused	Different fiber content and spacing	Civil Engineering
04'51"	User-Focused	Cognitive benefits of using translucent concrete	Architecture / Psychology
05'40"	User-Focused	Improve mental health	Economic / Psychology
06'06"	User-Focused	Spaces that ignite happiness and improve productivity	Architecture / Psychology

Table 3. User-Focused as sustainable solution noticed in video. Author's work (2022).

Sustainable solution: SDGs-centered.

Other factors of the solutions analyzed are framed in the SDGs, proposed by the United Nations to stop poverty in the world, protect the planet, and ensure that everyone enjoys peace and prosperity. The solution presented mentions direct ties to goals 3, 8, 9, 11, 12, 13. Table below shows the relationship between SDGs and the sustainability traits of the proposed solution. For example, the solution heavily points towards a cognitive benefit, which means it focuses on a psychological issue rather than a constructive one. It speaks of the increase in productivity and well-being of people who occupy infrastructures with translucent masonry. Such a trait is directly related to SDG 3, which points to health and well-being. This solution was found through the collaboration of the interdisciplinary team, to the architectural and psychological aspects that designed a new construction element.

SDG No.	Objective	The solution as an example	Student Area Contribution
3	Health and wellness	Translucent Autoclaved Aerated Concrete as masonry units will improve the wellness and productivity of users of the structure.	Architecture/ Psychology
8	Decent work and economic growth	Autoclaved Aerated Concrete will strengthen the dynamic and competitive economies.	Finance and Economy
9	Industry, innovation, and infrastructure	Translucent Autoclaved Aerated Concrete will encourage an inclusive and sustainable industry.	Civil Engineering
11	Sustainable cities and communities	Translucent Autoclaved Aerated Concrete will reduce the amount of billed energy, by natural light.	Architecture
12	Responsible production and consumption	Autoclaved Aerated Concrete in translucent masonry will have a responsible production of these blocks.	Civil Engineering

13	Climate Action	Use of Translucent Autoclaved Aerated Concrete will reduce CO_2 emissions.	Civil Engineering

Table 4. Sustainable Development Goals. Author's work (2022).

The interdisciplinary team contributed to considering solutions with sustainable traits such as low cost, innovation and creativity, user focus, and SDGs related to the solution proposed at the ACI competition.

Discussion

Interdisciplinary contributions require several disciplines to pursue a sustainable solution [22]. Specifically, engineering needs the intervention of professional architects, scientists, economists and financiers to propose a solution that is creative/innovative, low-cost, and user-centered because collaboration is a characteristic of an interdisciplinary solution [25]. The solution of using translucent AAC Masonry has sustainable characteristics such as being low-cost, creative/innovative, and user-centered.

The team in this case study is considered interdisciplinary because it is made up of students in different disciplines such as engineering, architecture, economics, animation and graphic design, and sign language. The contribution of each one was key to reaching a sustainable solution that meets the needs of the user and improves their quality of life. Each student had a voice and participated throughout the three weeks of work before submitting their proposal. For example, the engineering students oversaw improving the qualities of the concrete with the optical fibers. As mentioned above, this allows the concrete to be able to transmit more light into a room. This was a key suggestion by the architecture student since, with this type of concrete, access to light can be reduced to build larger spaces. Adding the optical fibers reduces the emission of CO_2 and the amount of cement used in the mixture, which makes this concrete more economical, a suggestion that came from the economics student. Finally, the graphic design and animation student oversaw making the video in a direct, fast, and appropriate way so that the proposed solution was easy to understand. The teamwork carried out in this competition reflects the importance of interdisciplinarity in daily life, and how the solutions obtained are an example of how and interdisciplinary group of work is one of many paths to improve people's quality of life. Future studies will aim to understand the interdisciplinary design process to understand the effectiveness of student´s contribution as interdisciplinary work.

Allowing professionals and students to cross traditional boundaries to create new solutions can leave variables unexamined due to the amount of information exchanged [12]. Nevertheless, a barrier to interdisciplinarity in education fields and workspaces is lack of communication [9], leading to difficulty of exchanging ideas to develop efficient and useful solutions. Without proper communication, the proposed traits to create new architectural spaces and engineering solutions can be lost. Thus, developing communication between professionals and students can prevent this situation and improve the solutions proposed.

Likewise, to improve the effectiveness of an interdisciplinary solution, it is important to promote communication and collaboration between professionals and students [16]. Although the participation of the interdisciplinary team members cannot be controlled, it can be monitored. Thus, results could be obtained from the collaboration of each discipline before the different proposals of other participants are shared, as well as from information about the process in which ideas are shared, discussed, and accepted. The result of this process is the creation of a comprehensive atmosphere in the team to establish a better understanding of the problem and propose appropriate solutions [1].

A very important characteristic of a sustainable solution is that it must be user-centered [23]. Interdisciplinarity in education and workspaces has demonstrated that it can generate user-centered solutions with the intervention of several disciplines. However, knowing specifically the requirements of the users is crucial to making the solution functional and effective [38]. In this case, a survey could be carried out to determine what users are looking for within the use of a structure. Thinking about the stakeholders and making the solutions user-centered requires obtaining important feedback to improve the design of these solutions [39].

Being able to count on an interdisciplinary team was an important key to being able to reach the results in the ACI competition's participant team and to understand that there is no limit to what can be created and innovated. The collaboration of different disciplines unites the best of several worlds of knowledge to be able to provide not only a structural solution, which is what an engineer looks for, but also a new way of living constructions, in the materials that are used and in how they will affect the final users' decisions. These multifaceted and interdisciplinary solutions have a lot of benefits related to sustainability [22]. Interdisciplinary collaborations allow the exchange of knowledge between professionals and students to address solutions that have a positive impact on the world. In future contexts, perhaps adding a scoring system, such as sustainability rating systems, can help spark such creativity and innovation towards direct sustainable goals.

Finally, it is known that interdisciplinary contributions are directly connected to sustainable development. The United Nations set the 17 SDGs to preserve the environment and its natural resources [19]. So, it would be interesting and profitable to find a way to include more SDGs in the sustainable solutions already presented. This can remedy current and future problems related to climate change, high consumption, and resource shortages [21]. Education is a good way to not only promote sustainable development in the classroom but to transfer it to the industry.

CONCLUSIONS

Nowadays, the world's challenges require innovative solutions to preserve the environment and its resources and improve our way of living. Interdisciplinarity is defined as the combination of knowledge coming from several disciplines to create creative, innovative, low-cost, and user-centered solutions. This preliminary exploratory study suggests that exposing students to interdisciplinary challenges supports their future contributions as professionals. This article analyzed the case study of an interdisciplinary team crafting the award-winning solution in a worldwide technical concrete contest. The award-winning proposed solution has interdisciplinary collaborations in terms of economic, environmental, and social characteristics. The team's solution had connections to SDGs 3, 8, 9, 11, 12, and 13. As for future work, researchers are working on interviews and focus groups with the students and advisor to analyze the interaction students had while working in the team, to understand better their cognitive design process when faced with other lenses of expertise and developing best practices to design such challenges in the classroom. Future studies will aim to understand the interdisciplinary design process to understand the effectiveness of student´s contribution as interdisciplinary work, and its connection to sustainable design traits. Furthermore, the researchers will aim to understand how to apply such interdisciplinary experiences into other experiences of the majors both within specific courses and between majors.

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