Original Article
ISSN (Online): 2582-7472

ShodhKosh: Journal of Visual and Performing Arts
International Conference on Multidisciplinary Aspects of Built Environment
June 2024 5(ICoMABE), 207–219

ALIGNING ARCHITECTURAL EDUCATION WITH SUSTAINABLE DEVELOPMENT GOALS: REFLECTIONS FROM GUJARAT, INDIA

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ABSTRACT

Architects have always encountered challenges when designing structures for the built environment. However, over the past decade, there has been a realization that the focus needs to shift from basic design, construction, and structural issues to sustainability problems. These problems require an integrated, adaptive, and participatory approach. Architectural practice and education need to continually evolve to address technical and methodological innovations and to respond to the challenges and demands of achieving the Sustainable Development Goals (SDGs).

Different approaches have been adopted worldwide to integrate various SDGs. Effective design pedagogies, methods, models, and initiatives have raised students' awareness of the sustainability implications of design and have been incorporated into architecture and planning curricula across the globe.

This paper is based on the author's years of engagement in practice, research, teaching, and assessment of various subjects in the discipline of architecture and planning across India. Primary data was collected by knowing the perspective of students and teachers, the types of design assignments, and the professional experience of architects. Subsequently, the approaches to the implementation of SDGs in architecture and planning courses were mapped, analyzed, and compared. This paper provides an overview of the level of emphasis on SDGs in selected architecture institutes in India. It further analyzes the challenges and opportunities for architects, students, and teachers in the case of Gujarat state. Finally, it outlines some actions institutes can take to move forward with the implementation of the SDGs, contributing to the current state of knowledge.

Keywords: Architecture Practice, Design Pedagogies, Sustainable Development Goals

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DOI 10.29121/shodhkosh.v5.i ICoMABE.2024.2275

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

1. INTRODUCTION

A common road map for peace and prosperity for people and the planet, both now and in the future, is offered by the 2030 Agenda for Sustainable Development. All of the member states of the United Nations ratified it in 2015. The seventeen Sustainable Development Goals (SDGs), which were created to take immediate action to encourage developed and developing countries to collaborate worldwide, are at the center of it all. As they address climate change and work to save our seas and forests, the SDGs recognize that eliminating poverty and other forms of deprivation must be done in tandem with programs that advance health and education, lessen inequality, and spur economic growth (United Nations, 2024).

According to "the Sustainable Development Goals Report 2023," which was just released, attaining the SDGs depends critically on tracking progress, directing policy, and guaranteeing stakeholder accountability. To ensure a thorough monitoring and evaluation process for the 2030 Agenda for Sustainable Development (United Nations, 2023), it emphasizes even more the necessity of creating a robust framework of indicators and statistical data. SDG 11 to SDG 15 particularly focus on building a safe, resilient, inclusive sustainable built and physical environment, sustainable energy consumption, and fight against climate change (United Nations, 2024). In the present-day context of climate change and ecological awareness, it is widely acknowledged that creating a sustainable built environment is a shared responsibility. More than one-third of the world's energy consumption and emissions come from the building sector. It includes the energy required for building construction, heating, cooling, and lighting homes, offices, and commercial spaces as well as the use of appliances and equipment (Buildings Energy System – IEA (11-7-2023).

Considering that the building industry uses half of the global energy, the importance of some key players, such as architects becomes much more important (International Energy Agency, 2018).

A society's ability to develop sustainably depends on the built environment, which is shaped in part by urban designers, urban planners, and architects. Training for future architects and engineers is crucial in creating a built environment's relevant and responsible design. They need to be trained to regularly integrate sustainability checks into their design process in addition to having a fundamental awareness of it (Koenigsberger, Ingersoll, Mayhew, 1975, P, 3,4, 31).

2. LITERATURE REVIEW

2.1. GLOBAL PERSPECTIVE ON SUSTAINABLE DEVELOPMENT GOALS AND DESIGN OF A BUILT ENVIRONMENT

The United Nations' Sustainable Development Goals (SDGs) have emerged as a key framework for tackling global issues and directing efforts toward a more sustainable future in recent years. Against the backdrop of the 2018 rebirth of the global movement of Climate Action, architects everywhere have assumed accountability for combating climate change and upholding the Sustainable Development Goals (SDGs) in practice and teaching. A movement towards increased awareness, proactive measures, and dedication to sustainability in architecture through both individual professional practice and policy-based systemic change is supported by the numerous global Architects Climate Action Networks in 2019.

However, to prepare professionals who can create and implement sustainable solutions for built environments, education in architecture and planning is essential. Researchers have concluded that the SDGs must be incorporated into architecture and planning courses to guarantee that aspiring professionals have the information and abilities needed to handle urgent environmental, social, and economic problems in society (United Nations, 2015).

According to an article written by Caballero (2019), the Sustainable Development Goals (SDGs) offer an innovative agenda that provides an outline to help us effectively face the fundamental obstacles of development, unlike the Millennium Development Goals (MDGs). The Sustainable Development Goals (SDGs) were designed to provide us with the tools necessary to meet the challenges of the Anthropocene age by bringing about a revolution in development and duty. To predict if these objectives will be met is premature. A study was conducted in Egypt on incorporating SDGs in architectural curricula (El-Kholei, Yassein,.2023). The above research concluded that the student’s awareness and understanding are not in line with the procedures needed for developing a sustainable built environment in the study area. Education in planning and architecture has little effect on changing students’ opinions. The study demonstrated that SDGs cannot be achieved without reforming planning and architecture education. The reform mandates that teachers teach students about critical thinking and theory. The graduate students and staff members must engage in related research that employs a combination of qualitative and quantitative investigation approaches. The study emphasizes that linking studio teaching methods to instructors' understanding of sustainability can help explain why sustainable development is unclear in Egyptian architectural and planning education, influencing both professional practice and scientific study.

A study was conducted by researchers (El-Kholei, Amer, and Yassein, 2024) which includes the case of integration of SDGs with the UG final year thesis project intending to contextualize and focus on local regions for sustainable development. The research indicates that Menoufia University's 2023 capstone project enhanced students' comprehension of sustainable urban development. The pupils' differing levels of receptivity to the ideas were mostly

focused on the SDGs. Women's rights and economic empowerment resonated with most of the female student body. The survey showed that the students struggled with time management, money constraints, and a dearth of Arabic reading materials.

The miscommunications between staff and students and the above-mentioned challenges, the collaborative activities took place outside of regular studio hours. The research concluded that it is possible to include sustainable design concepts in architecture education, but doing so requires careful and thorough preparation.

2.2. CIRCULAR ECONOMY(CE) CONCEPT, SUSTAINABLE DEVELOPMENT GOALS, AND DESIGN OF BUILT ENVIRONMENT

Recent years have seen a rise in the popularity of the circular economy (CE) as a mechanism that offers answers to some of the most urgent cross-cutting sustainable development issues facing the globe. Industrial ecology gave rise to the concept of the Circular Economy (CE), which attempts to amalgamate several already prevailing concepts from different scientific domains that have similar qualities and attributes. Industrial environments and synergies; the 3Rs principle (reduce, reuse, and recycle); cleaner production, encompassing the circular materials movements in industrial systems; product-service systems; eco-efficiency; cradle-to-cradle design; green growth; biomimicry; natural capitalism; the flexibility of social and ecological structures; and the notion of zero emissions are a few examples. Changing the "take-make-dispose" form of production and consumption is the aim of the CE paradigm, as it is now putting the sustainability of human life on Earth in jeopardy and driving humanity closer to the limits of the globe (Ghisellini, Cialani., Ulgiati., 2016).

By addressing the root causes, the concept of a circular economy has enormous potential to accelerate the implementation of the 2030 Agenda. This kind of economy revives natural systems, keeps goods and materials in use, and eliminates waste and pollution through design. Furthermore, the concept was repeatedly raised as an essential remedy during the Expert Group Meeting and thorough evaluation of SDG 12 on Sustainable Consumption and Production (SCP) at the 2018 High-Level Political Forum, especially concerning SCP and climate change, ocean action, and food waste and loss. Various reports emphasize that several SDGs, including those of energy, economic growth, sustainable cities, sustainable consumption and production, climate change, oceans, and life on land, can be particularly well-achieved with the help of the circular economy (CE).

A collaboration between stakeholders from all sectors was felt necessary to make the shift from a linear to a circular economy. Along with other stakeholders, major groups are crucial in accelerating the shift to a circular economy by organizing large groups of people to take concrete steps and applying pressure to governments and corporations to expedite implementation. In this context, an SBC Programme, which has implementation projects underway in Ghana, Senegal, and Burkina Faso in Africa, Bangladesh, Sri Lanka, and India, and in Asia, emphasizes circular built environments and sustainably obtained materials. The project concludes that when it comes to sustainable policies, such as housing programs, indicators can be used to evaluate the current situation, set goals, and keep an eye on trends. In Asia, Africa, and Latin America, SBC has arranged virtual workshops; the initial outcomes have served as a solid foundation for local adaptation and implementation. The global survey's results highlight a glaring gap: while circularity isn't specifically addressed in the SDGs, there are chances to investigate this further.

The literature suggests that while planning should consider building methodologies such as deconstruction, it also needs to align with vertical integration, tool developments, and policy results (Huovil, Iyer, 2022). Another research emphasizes that in the built environment, circular economy (CE) is widely acknowledged as an essential tactic for enhancing the sustainability of the building construction sector. In addition to providing practical answers to environmental problems, this approach can help achieve many Sustainable Development Goals (SDGs). Prefabricated modular building systems have shown to be a financially sustainable approach. This creates countless opportunities for circular construction systems. The development of sustainable techniques and material selection, however, remains incomplete and impedes the practical application of CE concepts. Moreover, there has been little research on the sustainability of modular building materials and components, and most of them have only addressed specific issues without taking the whole picture into account. To build modular components that are reusable and promote sustainability, it was suggested to use a topological interlocking system, which encourages reuse in design and construction through the use of topological interlocking components, sometimes known as modular or prefabricated components.

The study elaborates further and states that reusing above mentioned components in different construction projects helps cut waste and construction expenses because it is simple to join and disassemble. Building construction can be more environmentally friendly and effective while also conserving resources and using fewer materials. Furthermore, the Sustainable Development Goals (SDGs) can be achieved through the application of both cost-effective and environmentally friendly building techniques. This is particularly true for SDG 9 on infrastructure and industrialization, SDG 11 on sustainable metropolises and societies, and SDG 12 on responsible consumption and production (United Nations, 2015).

The researcher introduces the "rent to buy" approach as the foundation for a Circular Economy Business Model (CEBM) which facilitates reducing waste, promoting sustainability, and reusing modular building components (Zhuang, Shih, Wagiri, 2023). It can be concluded from the literature that it is crucial to combine the Circular Economy Business Model (CEBM), modular design, and material choice to realize the SDGs in the area of the built environment.

2.3. CIRCULAR ECONOMY (CE) CONCEPT AND SUSTAINABLE DEVELOPMENT GOALS (SDGS) IN INDIA

It is expected that in a short while, India's economy will rise to the third rank in the globe. The prime minister has emphasized that “Aatmanirbhar Bharat”, or "Self-Reliant India," will act as a boost for equitable and long-term high economic growth in India. The notion of Self-Reliant India is centered on sustainability and resolved to establish freedom for both the country and its society. Additionally, India can no longer choose to adopt the circular economy. India needs to move toward a circular economy immediately because of its growing population, urbanization, environmental issues, and international obligations.

Prime Minister Narendra Modi (2023) said that “India is turning to the circular economy as a key instrument for urban growth”. To encourage sustainable economic growth in India, several ideas have been suggested by the government think tank NITI Aayog. NITI Aayog has outlined 11 waste management priority areas to accelerate India's shift from a linear to a circular economy. One of the eleven priority areas is end-of-life products, which either still provide significant issues or are becoming new sectors that require a comprehensive approach. NITI Aayog has recommended specific actions to address obstacles to recycling garbage as a resource and to create a complete policy framework for the growth of an advanced recycling sector in India.

The introduction of Swachh Bharat Mission-Urban (SBM-U) by Prime Minister Narendra Modi in 2014 marked a major advancement in the Circular Economy (CE) agenda for municipal solid and liquid waste. The 3Rs reduce, reuse, and recycle are the cornerstones around which the mission has been built. With India increasing its ability to process solid waste from 18% in 2014 to over 68%, it has been a great success. Fly ash and slag produced in the steel industry and other sectors have seen significant advancements in utilization as building material or infrastructure building. Reducing, Reusing, Recycling, Redesigning, Remanufacturing, Refurbishing, and Repairing are the seven Rs of the circular economy, which should be implemented. Business parks, industrial clusters, and new urban development initiatives should all be designed with the above ideas in mind. India can become a manufacturing powerhouse and meet its climate change commitments with a stable and encouraging regulatory environment for a Circular Economy (CE) (Admin,2024). India is committed to accomplishing the 17 SDGs and is a party to the 2030 Agenda for Sustainable Development. The nation has adopted, implemented, and monitored SDGs by taking proactive measures at the national and state levels. India is dedicated to regularly taking part in the global assessment of the Sustainable Development Goals (SDGs) progress. Many architecture and planning institutions in India have adopted the universal trend of incorporating sustainability and SDGs into their curricula.

The Sustainable Development Goals (SDGs) have emerged as an essential framework for tackling global issues, particularly those of Indian architectural education. The Sustainable Development Goals (SDGs) must be incorporated into architectural education if the country is to produce future professionals who can support sustainable built environments. To bring education into line with both national and international sustainability agendas, architecture schools in India are placing a growing emphasis on the SDGs in their curricula. To achieve this integration, social justice, economic viability, and environmental sustainability must be incorporated into the planning and architectural design processes. For example, courses might cover subjects like resilient infrastructure, inclusive urban development, climate-responsive design, and green building technologies (Ghosh & Wij, 2020). Moreover, the integration of sustainable methods in architecture education is being encouraged by cooperative endeavors among academia, government, and

industry. The National Education Policy 2020 is one initiative that encourages universities to integrate Sustainable Development Goals (SDGs) into their research and teaching operations. It also emphasizes holistic and interdisciplinary methods. The need to develop faculty members' capacity, integrate the SDGs into architecture education at all levels, and put knowledge into reality are some of the issues that still need to be resolved. However, with coordinated efforts and collaborations, India's architectural education can make a substantial contribution to the advancement of sustainable development and the creation of resilient, inclusive built environments.

2.4. INTEGRATION OF SUSTAINABLE DEVELOPMENT GOALS (SDGS) IN GUJARAT, INDIA

The government of Gujarat is taking a holistic approach to address the implementation of SDGs in the state. The government has formed the Thematic Working Groups (TWG) to integrate the SDGs in each sector by reviewing existing policies, and programs and tracking the progress. The government is insisting and incentivizing schools and universities to incorporate sustainability into their curriculums. Recycling, energy efficiency, use of solar energy, use of green technology, carbon-neutral methods, and responsible consumption have been promoted at the state level (Shankar, 2024).

2.5. INTEGRATION OF SUSTAINABLE DEVELOPMENT GOALS (SDGS) IN ARCHITECTURE AND PLANNING EDUCATION

The Brut land Report to the World Commission (United Nations) in 1987 defined sustainability as

” Progress that fulfills current needs without endangering the capacity of future generations to satisfy their own needs." In addition to "preserving the interest of future generations," this movement also aims to preserve "the earth's capacity to regenerate." The report further emphasizes that to achieve sustainable development it is essential to "integrate sustainable development principles, values, and practices into all aspects of education and learning." A comprehensive strategy for sustainability has Environmental Preservation, Social Responsibility, and sound Economic Principles comprising the three pillars (Pipralia, 2020). Architecture and Planning are academic fields that support the comprehension and utilization of these three sustainable building pillars.

In the modern day, Architecture and Planning are popular subjects that are expanding rapidly both internationally and within India. It has a significant influence on modern practices and policies. In addition to helping us learn from the past, it has a significant influence on present practices and policies that shape our culture, infrastructure, and society. Architecture and Planning profession may help create sustainable communities and provide a foundation for many disciplines to understand and apply sustainability practices and ideas into their respective curriculum, even though there are obstacles in integrating sustainability concepts into the curricula. Studies have shown how Architecture, as a discipline, can help teach and promote the idea of sustainability.

The Indian government established the Council of Architecture (CoA) in the year 1972 under the provision of the Architects Act 1972. According to the act, architects must register, and adhere to rules of practice, education requirements, and recognized certifications. Together with keeping the registration of architects, the Council of Architecture is also responsible for regulating professional practice and education in India. Under the Architects Act, the Council of Architecture has formulated regulations and the Government of India has approved the rules that the Council of Architecture has outlined for this purpose (CoA, 2024). More than 423 institutes in India provide certified degrees along with architectural education. The educational standards offered in these institutions (IITs, NITs, and independent institutions, constituent institutions/departments of universities, deemed universities, associated colleges/schools,) are governed by the Council of Architecture (Minimum Standards of Architectural Education) Regulations, 1983. These rules outline the prerequisites for enrollment, the length of the course, the accommodations and staff standards, the course material, the test, and other details.

Within the recommended curriculum, the CoA gives priority to topics related to sustainable development, such as "building services and equipment, architectural history, and climatology," as well as concepts related to "energy conservation, ecology, environmental pollution, urban renewals, rural settlements, and economic development at different levels." The research conducted through case studies of Architectural Education institutes in India concludes that the curriculum, courses, and content of Higher Education Institutes (HEIs) are not even close to being in line with sustainable development, despite evidence to the contrary. The degree programs in this field only tangentially

correspond to the SDG requirements. Although there are very few electives in this subject that specifically address the SDGs, the programs it offers are only loosely in line with the standards of those goals. Core courses in sustainability do not exist (Sharma, Bhatnagar, Kalra, 2023). Sustainable growth necessitates a mindset shift that results in behavioral change. Education is critical to sustainable growth since it changes an individual's viewpoint.

Other researchers emphasize that several key conditions must be satisfied to successfully integrate SDGs into architectural and planning education. First, curriculum revision is required to incorporate sustainability concepts, environmental stewardship, and social equity into foundational courses. Furthermore, because sustainability concerns are interconnected, multidisciplinary approaches that promote cooperation between environmental research, social sciences, design, and planning are crucial. Furthermore, students gain a practical grasp of the application of sustainable design concepts through practical learning opportunities such as internships, case studies, and real-life projects.

3. CONCEPTUAL FRAMEWORK

It can be concluded from the findings of the literature review that the current curriculum of architecture and planning courses is not even close to being in line with sustainable development though energy efficiency in buildings and climate-sensitive design have long been taught in architectural schools. However, the unit courses are fragmented and the coursework isn't used to its full potential. The students require an integrated method to have an effective environment-responsive plan.

It is necessary to break down the barriers in the professional and educational spheres that prevent the teaching of environmentally conscious sustainable architecture and planning education. The syllabus must be updated and revised as per current needs and effective instruction. Additionally, it is critical to begin introducing students to sustainable environmental design in their early years of study to adequately prepare them for the challenges that excessive construction activities will inevitably pose to the balance of the environment. Different approaches have been adopted across the globe to integrate various SDGs, and there are successful design pedagogies, strategies, models, and initiatives that improve students' awareness of sustainability aspects of design already integrated into the existing architecture and planning courses around the world. Hence it is vital to have an overview of the level of emphasis on SDGs in architecture and planning curriculum. It is also important to analyze the challenges and opportunities for architects, students, and teachers with the implementation of SDGs.

In the context of the above, this study focuses on architecture and planning teachers', and students' knowledge, attitudes, and activities to reflect their sustainability awareness.

The research questions are

- What are the number, level, and pedagogy of teaching sustainability courses in the architecture and planning syllabus?
- What are the barriers the teachers, professionals, and students experienced in integrating sustainability into architectural design and planning?

4. METHODOLOGY

This study examines the development of environmental awareness among Indian architecture and planning students and how it relates to the integration of SDGs or sustainability concepts. The aim is to develop academics and practitioners who can tackle sustainability issues effectively, addressing water, waste, physical and built environment, and climate change mitigation. This paper is based on the author's years of engagement in practice, research, teaching, and assessment of various subjects in the discipline of architecture and planning courses across India.

The data for the study was gathered through two sources. The secondary data (course names, detailed syllabus, assignments) was collected through various institute websites and student term work. The primary data was collected by interviewing teachers, students, practicing architects, and research assistants associated with the selected institutes. Subsequently, the approaches to the implementation of SDGs in architecture and planning courses were mapped, analyzed, and compared. The article gives a summary of how much focus is placed on the SDGs in architecture institutes in a particular region (Gujarat) in India.

It further analyzes the challenges and opportunities for architects, students, and teachers. Finally, it outlines some actions institutes can take to move forward with the implementation of SDGs, contributing to the current state of

knowledge. The author used different approaches for their data analysis. The researcher created a questionnaire survey under the research goals to look into the current state of SDG integration into architecture and planning education consider incorporating SDGs into curricula, and pinpoint areas for improvement. Semi structured interviews, FGDs, and telephonic surveys were conducted with 60 students studying in UG, and PG courses, 10 teachers associated with them, and 10 practicing architects during November -December 2023.

There were 65 teachers and architects who finished the entire questionnaire, indicating a good response rate of 81%. Some questions used both open-ended and closed-ended formats, requiring participants to select from predetermined options to create a consistent framework for comparing replies. The authors analyzed the responses using techniques for data analysis.

Figure 1

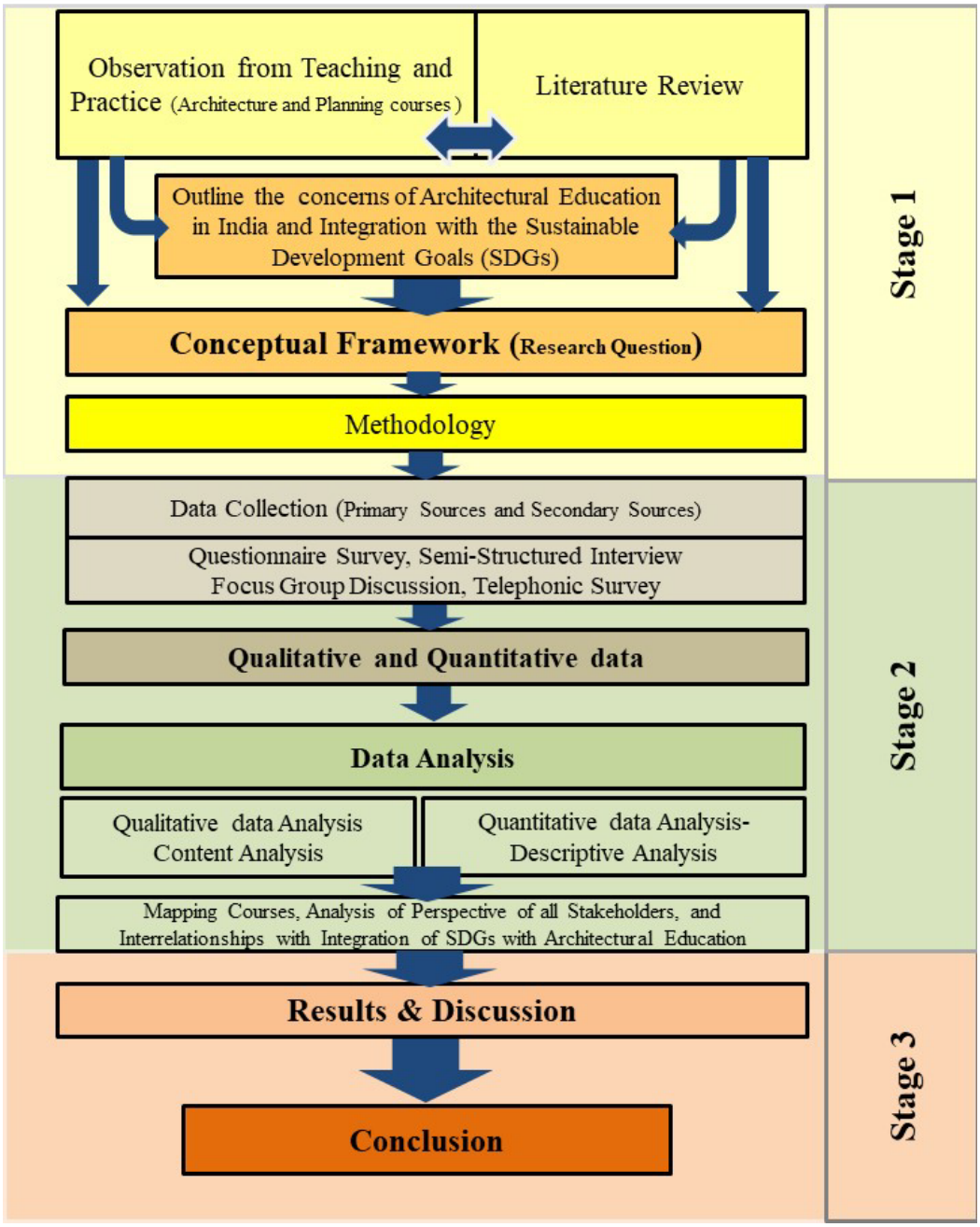

Figure 1: Research Design and Methodology

Source: Drawn by the Author

5. RESULTS AND DISCUSSION

5.1. COUNCIL OF ARCHITECTURE (COA), ARCHITECTURE AND PLANNING INSTITUTES: SUBJECTS FOCUSING ON SDGS

Examining the current curriculum of India's top-ranked Architecture and Planning Institutes, it is observed that while the titles of the disciplines varied from institution to institution, the themes were constant and in line with CoA and AICTE guidelines. Further investigation was focused on specific subjects focusing on teaching SDGs and their implementation in the Architecture and Planning fields. The study reveals that the specific core and elective subjects teaching concepts of sustainability are Climatology, Climate and Design, Climate and Sustainability, Landscape Design, Ecology and Planning, Habitat and Environmental Planning, Rural Area Planning and Development, Planning for Sustainable Rural Development, Disaster Mitigation and Management, Urban Sustainability and Future City (elective). The highest weightage to the subjects focuses on SDGs and their implementation is a maximum of 5 percent of total credit in the entire B. Arch. and Planning program.

However, the Design or Architectural Design and Planning Studio subjects are given the highest weightage in B.Arch., and Planning programs across all institutes.

Based on an analysis of the curricula of highest-ranked architecture schools, Varkey, Tom, and Augustine's study from 2022 on the B. Arch. programme finds that most of the sustainability training is found in the second and third years of the programme. Over the course of the five years, the fundamental courses are spread out, while the Building Science and Applied Engineering courses are concentrated mostly in the second and third years. Fourth and final year students take a larger percentage of elective courses. CET, Trivandrum, CEPT, Ahmedabad, BITS, Ranchi, and BMS, Bangalore do not provide any first-year courses relating to sustainability, however AMU, Aligarh, and SPA Bhopal each have more balanced curricula, with courses spread almost evenly across five years.

A study of the curriculum of architecture and planning institutes in the Western region shows that SDGs and climate change are discussed as part of subjects called Climatology, Climate, and Design, Climate and Building, Green and Smart Building Design Concepts, Advanced Climate Design (E), Sustainable Development Goals (E), Sustainable Architecture (E), Bio-mimetic Architecture (E), Environmental Science and Green Concepts, Sustainable Architecture, Environmental Science and Sustainability. Recently CoA has taken the initiative and instructed the architectural institutes to revise the curriculum to integrate the following subjects to address the impact of climate change in the Global Scenario. The CoA recommends core courses named Net Zero Resilient Design (PC), Built Environment and Climate Change, Building Science and Performance Measurement, and Environmental Performance Simulation and Analysis (BS &AE). Advanced Vulnerability Assessment Method, Advanced Building Performance Assessment Methods (PE) (CoA, 2024).

5.2. SUBJECTS FOCUSING ON SUSTAINABLE DEVELOPMENT GOALS (SDGS) - PERSPECTIVE OF TEACHERS, STUDENTS, AND PROFESSIONALS (GUJARAT, INDIA)

From various institutions offering UG and PG courses in Architecture, Urban Planning/Urban Design in the state of Gujarat (Western region), India, about a total of 80 replies from teachers, professionals, and students were received. Young assistant professors and practicing architects consist of about 18% of respondents followed by associate professors or professors and senior professionals (10%) and about 72% of respondents are students. The maximum number of respondents are architects with more than four years of experience. Remaining have the experience of more than two years.

Among students, 30% of respondents are from UG, and about 16% are studying in PG. About 26% of respondents belong to the practicing architect’s category. Both teachers and practicing professionals are about 11%. Only teachers are about 6 % and the remaining are architects and planners practicing architecture and studying planning (refer to Table 1 and Figure 2).

Table 1: Category and Number of Survey Respondents

Sr. No.	Category of Survey Respondents	Number of Survey Respondents
1.	Students of B. Arch.(UG)	24
2.	Students of M.Plng.(PG)	12
3.	Teachers (UG and PG)	12
4.	Practicing Architects	27
5.	Practicing Planners	1
6.	Practicing Architects and PG student	6
7.	Others	6

Figure 2

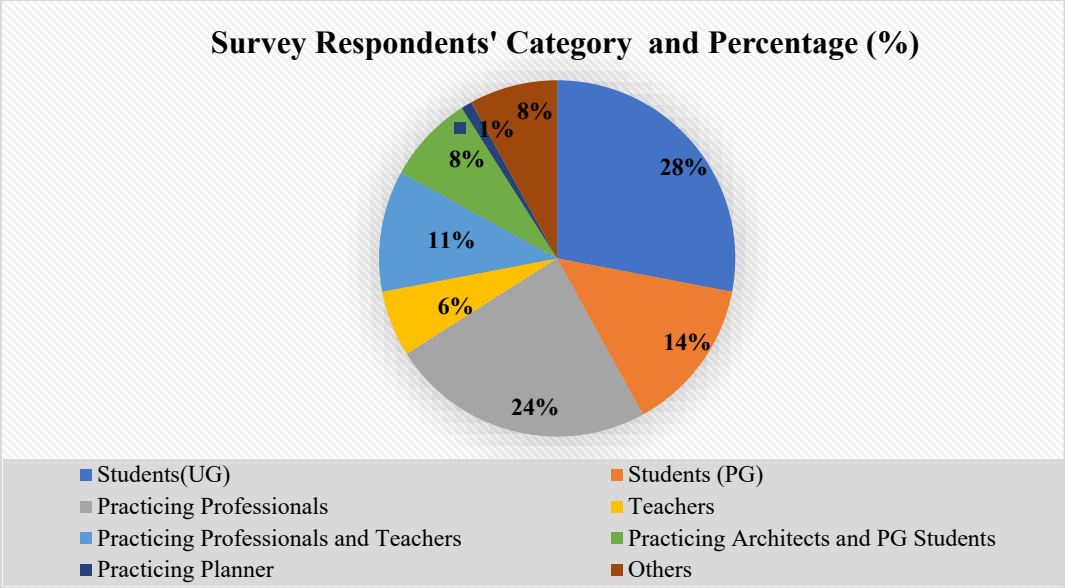

Figure 2: Survey Respondents' Category and Percentage

Source: Survey data analysis by author

When asked a question about first exposure to the SDGs goals related question, it can be concluded from the analysis that the maximum number of respondents were exposed to sustainability-related knowledge in B.Arch. II, III and IV year (UG program) (31%) and about 16% learned early during the B. Arch.I (first year of UG program). About 13% of students learned it in the fifth year of the UG program. However, about 27% of the respondents learn SDGs during their work or practice. About 23% of respondents learned about SDGs in the first-year PG program (refer to Table 2 and Figure 3).

Table 2: Number of Survey Responses at Various Learning Stages about SDGs

Sr. No.	Learning Stage (about SDGs)	Number of Survey Responses in Each Category
1.	Before B.Arch (UG)	06
2.	During B.Arch (I year) (UG)	10
3.	During B.Arch (II-IV year) (UG)	23
4.	During B.Arch (Vyear) (UG)	08
5.	During PG (I-II)	09

6.	During Practice	16
7.	Self-Learning	06
8.	Any Other	02

Figure 3

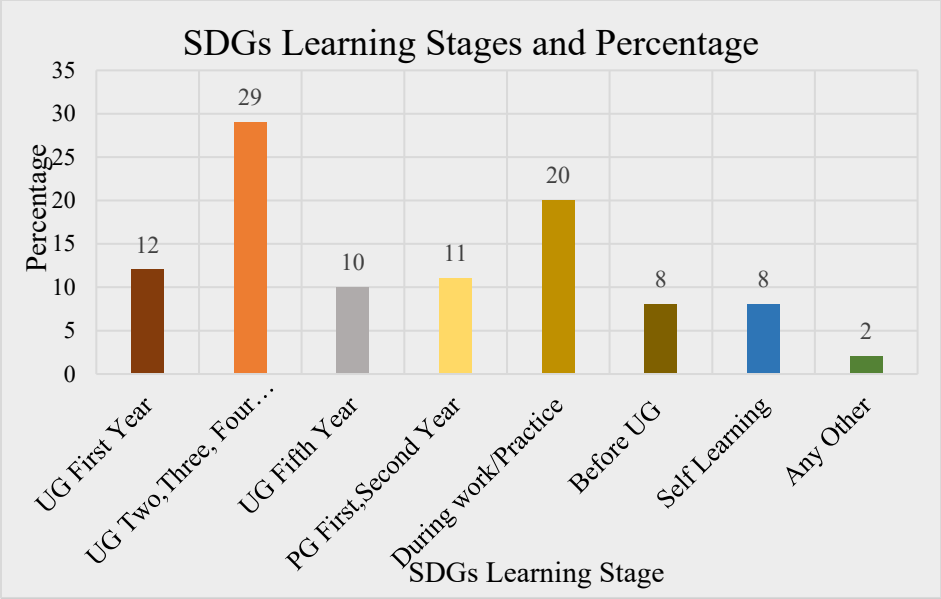

Figure 3: SDGs (Sustainable Development Goals) learning stages and percentage of category-wise survey respondents
Source: Survey data analysis by author

5.3. INTEGRATION OF SDGS OR SUSTAINABILITY CONCEPTS IN ARCHITECTURE AND PLANNING EDUCATION

This section looks at how important it is to include sustainability in architectural education and what are the different ways respondents integrate the SDGs. Figure 3 illustrates how a student or professional integrates sustainability-related ideas in design and planning. The importance of incorporating passive design concepts was practiced by 26% of the respondents. About 60% of respondents were exposed to both active and passive methods of achieving sustainability in architectural education. About 6% of respondents expressed knowledge only about the application of active systems to achieve sustainability in built environment design. (refer to Table 3 and Figure 4).

Table 3: Number of Survey Responses about the Application of SDGs Concepts in Building Design

Sr. No.	Application of SDGs (Sustainable Development Goals) concepts in design	Number of Survey Responses
1.	Passive Design Concept	21
2.	Active Design Concept	05
3.	Passive and Active Design Concept	48
4.	Any Other Concept	06

Figure 4

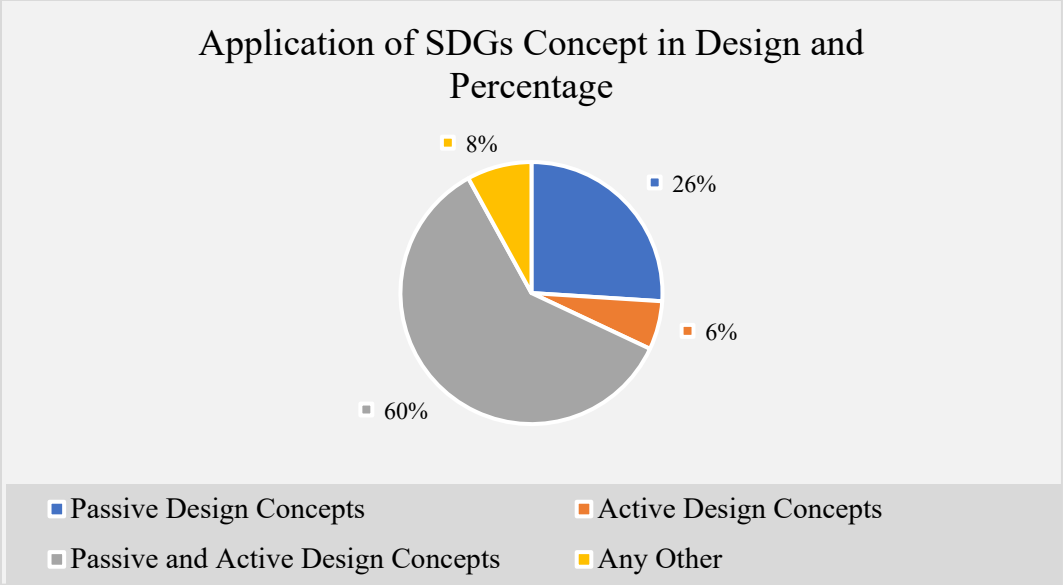

Figure 4: Application of SDGs (Sustainable Development Goals) concepts in design and percentage
Source: Survey data analysis by author

The in-depth interview was conducted with various stakeholders to understand the application of various concepts to achieve sustainability. The insights from the interviews demonstrate that

"Natural Ventilation" or wind direction and "Light from North direction" are the only approaches used in architectural design projects starting in the first year to the third year. A lot of detailed inputs are given through conducting theory classes in Climatology or Climate and design subjects. However, a huge gap is found between theoretical inputs and their application at the advanced-level institution building design or Housing design. Strategies such as "water conservation" "water harvesting" "waste management," "solid waste management," "energy optimization"- and "socio-economic strategies" are only included in the

B. Arch.III (third year of UG program) and second semester of the Master of Planning program. The advanced concepts such as "Circular Economy" "Life cycle costs", "Optimization" and "Climate Change" are not discussed both at UG and PG levels which can discourage the processes of integration of the SDGs in the curriculum.

5.4. OBSTACLES TO THE INTEGRATION OF SDGS STRATEGIES IN THE FIELD OF ARCHITECTURE AND PLANNING:

The challenges of implementing sustainability into architecture and planning education and professional practice are discussed in this segment. The 12 most possible reasons were mentioned in the questionnaire. The respondents were asked to select all possible reasons. The analysis shows that the following two reasons were selected by the highest number of respondents.

- Lack of effective knowledge
- Lack of clarity of concepts and their integration into the design

The "high cost for applications of such concepts" was considered one of the second-highest reasons for the non-integration of the SDGs concept into design. The last two low-scored reasons are "lack of willingness of professionals" and "lack of time to integrate concepts of SDGs into design or planning projects". Few respondents also considered that the "lack of willingness of teachers to appreciate the concept integration process" also becomes a barrier in the said process. The respondents were also asked about their experience regarding the level of integration of SDGs into the design. The highest number of respondents have experienced about 40% integration of SDGs have materialized in regular academic design exercises and professional practice.

6. CONCLUSION

Education is considered essential for achieving “Sustainable Development Goals (SDGs)” (UN,2023). This study examined the degree of SDGs integration in architecture and planning education through curriculum analysis, literature review, and the perspectives of students, teachers, and professionals from Gujarat. The gaps, opportunities, and difficulties in integrating the SDGs into architecture and planning curricula were determined after a thorough analysis.

The final thoughts were created based on the preliminary research questions (RQ) presented at the start of this work:

- What are the number, level, and pedagogy of teaching sustainability courses in the architecture and planning syllabus?
- What are the barriers the teachers, professionals, and students experienced in integrating sustainability into architectural design and planning?

The data gathered from secondary sources, the literature review, and additional examination of the UG and PG courses, subjects, and comprehensive syllabus provided the answer to the first research question (RQ). The first main conclusion from this study is that top-ranked higher education institutes (HEIs) curriculum, courses, and content are not even close to being aligned with SDGs. The literature review reveals that the SDGs requirements are only loosely matched with the programs provided in this discipline, and very few elective courses cater to the above specific requirement.

The second main conclusion is that even at the regional level (Gujarat state) institutes, the curriculum research shows that the B.Arch program's sustainability training is mostly focused in the second and third years, with additional electives offered in the fifth year (refer to Figure 3). This strategy has to be re-examined, with extra courses added in the first and second years to help students learn the fundamentals in the initial years. In order to work on architecture design (UG) and planning studio (PG) projects throughout their third and fourth years of study, students can thus employ their advanced understanding of "applications and software and simulation tools."

The scrutiny of data gathered from secondary sources and qualitative and quantitative analysis of stakeholders' viewpoints were used to address the second research question (see Table 3 and Figure 4).

The third main conclusion shows that different contents of SDGs and climate-sensitive design concepts have been taught within various core and elective subjects. However, the application of SDGs and climate-sensitive design concepts in Design or Planning projects is minimal (5 %). Passive design concepts are found to be applied by only 30% of the total respondents which should be mandatory for each designer and planner.

The fourth key conclusion shows the reasons for a low level of integration of SDGs in architecture and planning courses. The lack of effective knowledge, clarity of concepts, required time to explore integration methods, and unavailability of suitable building materials are the most important reasons for the low level of integration of SDGs. The findings point to the necessity of a suitably varied and well-rounded curriculum, as well as an evaluation of design assignments, a list of appropriate construction techniques and building materials, and pre-preparation before the start of the session, to develop a multi-level strategy and offer an engaging and adaptable learning environment for the deep integration of SDGs into planning and design programs. Advanced knowledge of Circular Economy (CE) and optimization must be applied in the higher classes to achieve SDGs while students are working on their six-month-long thesis projects both in UG and PG programs.

Promotion for incorporating sustainability concepts into the first-year (UG, PG) curriculum and emphasizing software-based and hands-on learning is vital. Real-world case studies, practical training, workshops, and regular idea sharing by working professionals should be used to raise awareness and increase teachers' and students' understanding about integration of SDGs in UG and PG programs.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

The researcher expresses gratitude to all academic staff, industry professionals, and students who contributed to this study by taking the time to complete the questionnaire survey, in-depth interview and participated in Focus Group Discussions (FGDs).

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