

Received 5 June 2024: accepted 22 August 2024.
Available online 25 August 2024

A sustainable development comprehensive view in architectural education: Case study to reimagine the urban public space with a special focus on Giza Zoo

Mennatallah Tawfik

Assistant Professor in
Architecture and Urban
Design Program -

Nile University

Cairo, Egypt

mtawfik@nu.edu.eg

Mirame ElSayed

Instructor in Architecture
and Urban Design
Program

Nile University

Cairo, Egypt

mimahmoud@nu.edu.eg

Shaimaa Emad

Teaching Assistant in
Architecture and Urban
Design Program

Nile University

Cairo, Egypt

Semad@nu.edu.eg

ABSTRACT:

Tackling sustainable development from a comprehensive approach still needs to be well yielded in academia and research in the undergraduate curricula of most urban studies. This paper presents teaching and learning experiences in architectural education in the sustainable development field. It experiences different theoretical and practical approaches given in an undergraduate elective course to students in the Architecture and Urban Design Program (ARUD) at Nile University. Different teaching processes are shown through class activities, a peer-to-peer review, linking with industries, group discussions, writing a critical review of scientific papers, outlining the urban challenges and proposing sustainable strategic approaches of "lost urban spaces" with a particular focus on Giza Zoo. Moreover, it raises the ability to mandate the effectiveness of proposed solutions into applicable and integrative solving scenarios. In summary, this research encompasses comprehensive sustainable development approaches in architectural education to highlight the potential and beneficiaries of the proposed methods in architectural pedagogy seeking urban development. The proposed teaching strategies address the potential for improvement in architectural education in the sustainability field and show initiatives for urban planners, urban designers and policymakers to enhance public space design through sustainable development considerations.

Keywords: Architecture education, sustainable development, smart solutions, comprehensive sustainable design

رؤية شاملة للتنمية المستدامة في التعليم المعماري

دراسة حالة لإعادة تصوير الفراغ العام الحضري مع ذكر خاص لحديقة حيوان الجيزة

شيماء عماد	ميرام السيد	منة الله توفيق
معيد في برنامج العمارة والتصميم العمراني – جامعة النيل	مدرس مساعد في برنامج العمارة والتصميم العمراني – جامعة النيل	أستاذ مساعد في برنامج العمارة والتصميم العمراني – جامعة النيل
Semad@nu.edu.eg	mimahmoud@nu.edu.eg	mtawfik@nu.edu.eg

الملخص

لا يزال دمج التنمية المستدامة بنهج شامل بحاجة إلى تحقيق نتائج ملموسة في الأوساط الأكاديمية والبحثية ضمن المناهج الجامعية لمعظم الدراسات الحضرية. تعرض هذه الورقة البحثية تجارب عمليات التدريس والتعلم في التعليم المعماري في مجال التنمية المستدامة. وتشمل هذه الدراسات على اختبار مناهج نظرية وعملية مختلفة مقدمة في مادة دراسية اختيارية للطلاب الجامعيين في برنامج الهندسة المعمارية والتصميم العمراني (ARUD) بجامعة النيل. يتم عرض عمليات التدريس المختلفة من خلال الأنشطة الصفية، واستعراض النظائر، والربط مع الصناعات، والمناقشات الجماعية، كتابة تحليلات نقدية للأوراق البحثية، ثم تحديد التحديات الحضرية واقتراح مناهج استراتيجية مستدامة "للمساحات الحضرية المفقودة" مع التركيز على حديقة حيوان الجيزة. بالإضافة إلى ذلك، يؤكد البحث على فعالية الحلول المقترحة المتكاملة في سيناريوهات الحل القابلة للتطبيق. يتضمن هذا البحث مناهج التنمية المستدامة الشاملة في التعليم المعماري لتبسيط الضوء على فوائد وتأثيرات الأساليب المقترحة في التربية المعمارية التي تسعى إلى تعزيز التنمية الحضرية. تتناول استراتيجيات التدريس المقترحة إمكانية تحسين التعليم المعماري في مجال الاستدامة وتظهر مبادرات للمخططين الحضريين والمصممين الحضريين وصانعي السياسات لتعزيز تصميم الأماكن العامة من خلال اعتبارات التنمية المستدامة.

الكلمات الدالة: التعليم المعماري، التنمية المستدامة، الحلول الذكية، التصميم المستدام المتكامل

INTRODUCTION

Although integrating sustainability into education is very crucial, it has not yet to be fully addressed in educational pedagogy, encompassing all dimensions of sustainability from a comprehensive approach. This research suggests varied teaching methods that incorporate sustainable development and enhance students' capacity for critical thinking and research skills. This research also shows the importance of interactions and connection between students and industry practitioners. Furthermore, this paper demonstrates the outcomes of this comprehensive learning approach and how it might be applied in different public spaces to be restored as part of a sustainable urban setting.

The increasing recognition of sustainability dialogues importance in architectural education has led to extensive discussions in the literature. However, these discussions often address the sustainability concept in fragments while not overlooking the comprehensive nature of sustainability, that extends beyond the environmental aspect to include all the other fundamental dimensions. This paper is structured into four parts. The literature on sustainability in architectural education is discussed in the first section. The second section describes the methodology of the undergraduate course teaching

pedagogy. Part three presents the results and discussions, followed by the conclusion section.

1. LITERATURE REVIEW

1.1. Integrating Sustainability into Education

Ismail et al. (2017) mentioned that the UK and USA cases had very diverse curricula, and the authors needed more studies on the identification of distinctive approaches to integrating sustainability into the program. Iulo et al. (2013) suggested four radically different approaches to sustainability education: core value, system-focused, choice, and specialization.

In the Asian context, studies revealed that sustainability principles were not adequately implemented in studios, and the content was heavily biased toward technology (Rieh et al., 2002) and digitalization (Rieh et al., 2017). Conversely, Shari & Jaafar, 2006; Álvarez et al., 2016, found that many of the programs dealt with environmental issues, focusing on energy, while only a few addressed socio-cultural issues. The majority of the programs have some deficiencies in addressing economic issues, causing difficulties in implementing sustainable programs using existing curricula. A Korean study that looked at programs recognized by the KAAB found that there was very little attention paid to sociocultural issues while there was a strong emphasis on technology and environmental concerns (Rieh et al., 2017).

Salama and Amir (2005) pointed out a general imbalance among studied 18 programs across many Arab countries. They identified three paradigms: environment-behavior studies, sustainability and environmental consciousness, and digital and virtual practices. They also found a general need for more integration between theory and studies. Similarly, Benkari (2013) conducted an analytical study in the UAE and highlighted the need for urgent global integration of the concept of sustainability into architectural education, arguing that such integration would enhance the academic formation of architects.

As result, universities take different approaches in offering sustainable architectural education. There is also a need of a particular approach acquisition to integrate knowledge of sustainability into the academic curriculum.

1.2. Sustainability in Architectural Education

In 2004, the concept of sustainability was embedded within the Conditions for Accreditation for Professional Degree Programs in Architecture in the United States of America (Adegbile, 2012). In 2012, a special report funded by the Carnegie Foundation in the United States criticized accrediting systems, stating that sustainable architecture should be mainstream, not a topic for a particular group of professionals or a trendy set of ideas (Boyer & Mitgang, 1996). Similarly, the 2012 Sustainable Architecture Education White Paper highlighted a global agenda for implementing sustainability in accredited architectural education programs, highlighting the challenging task for

accrediting bodies to balance normative requirements with academic freedom (Trachte et al., 2012).

Scholars have proposed different approaches to sustainability integration in the architectural education; Wright (2003) suggested three methods: full embedding, parallel integration, and focusing on design studios as interdisciplinary workspaces (Altomonte et al., 2012). The comprehensive embedding approach embraces the belief that sustainable design is essential to architecture studies, and isolating it from fundamental theory and practice is improper. El-Feki and Kenawy (2018) also demonstrated the importance of incorporating sustainability within architectural education, suggesting an interdisciplinary collaboration between different fields. This paper shows specifically the 'sustainable development' course outcomes and its diverse teaching methods at the Architecture and Urban Design Program (ARUD). The approach to teaching taken in ARUD assumes that the nature of sustainability and its incorporation should be embedded into many modules of the architectural curriculum.

International Union of Architects (UIA) accreditation's first criterion in educational programs ensures the balance between theory and practice in education (UNESCO - UIA, 2002; Guadet, J. et al., 1909). Similar to Wright's (2003) approaches, Sterling (2001) developed an action plan to guide educators, practitioners, and decision-makers in incorporating sustainability dialogues into education. Three main transitional stages were outlined in his plan: policy setting, reformatory, and transformation. There are some educational systems that have been adopted in the first stage, the next two show more challenging reorientations towards sustainable practice. The challenge relied on the transformative nature of education, which takes a long period of time and happens in phases based on a particular course structure and its intended learning outcomes (ILOs). El-Feki and Kenawy (2018) mentioned the importance of involving policymakers to raise the awareness of students through workshops and campaigns to encourage wider university community engagement, cross-sector collaboration, and curriculum enhancement.

From a Dupre global perspective, sustainable development necessitates collective knowledge and effort, as it is inherently holistic and interconnected (Ismail et al., 2017). There is a consensus among academics, environmentalists, and government representatives that achieving sustainability requires balancing environmental, sociocultural, and economic endeavors (Rieh et al., 2017). The European Parliament (2010) proposed that globally-minded and holistic professional architectural education in sustainability is essential because the built environment is responsible for many environmental issues. For example, buildings account for nearly more than 40% of global energy consumption and one-third of global greenhouse gas emissions (De Gaulmyn & Dupre, 2019).

Higher education institutions play an essential role in the advancement of sustainability. Architects and urban planners are the professionals who play the role of integrating the design with all the sustainability aspects to create well-designed livable urban

environments (Gharib et al., 2022, Siraj et al., 2018; Jamieson et al., 2011; Karatepe et al., 2012; Hattan et al., 2010; Altomonte, 2009). Sustainable architecture education has recently been integrated into the architectural curriculum to prepare upcoming graduate architects with the knowledge and skills to protect the environment and conserve natural resources (Hattan et al., 2010; Filho et al., 2018). Their contribution should hold current urban values while developing new effective values formation.

Researchers propose that the development of architectural education as a process should initiate and facilitate more effective actions in sustainable development (Dabaieh, El Mahdy, & Maguid, 2018; Mohamed & Özkan, 2018). Higher education institutions are platforms for disseminating the Sustainable Development Goals (SDGs) proposed by the United Nations (UN), which are largely dependent on educational institutions and the teaching curricula at schools and universities (Gómez-Galán et al., 2020; López López et al., 2019; Efthymios et al., 2009). Despite the fact that geographical context for SDGs implementation varies significantly, these institutions decisively foster a mindset that promotes the dissemination of SDGs principles (Žalėnienė & Pereira, 2021).

There is also the supportive system of the “Quality Education” in embedding the inclusion of environmental aspects in the architectural programs' curricula. It is one of the United Nations "Sustainable Development Goals" charters, highlighting target 4.7, "Education for Sustainable Development and Global Citizenship" (UNESCO, 2014a). It ensures that by 2030, learners should acquire the knowledge and skills to foster sustainable development and promote human rights, gender equality, a culture of non-violence and peace, global citizenship, and the appreciation of cultural diversity (Campos, 2020).

Olotuah (2000) claim that the concept of learning is not limited to acquiring academic knowledge and skills but also includes various processes that contribute to the holistic development of the learner. These processes encompass the physical, moral, intellectual, and emotional aspects, ultimately shaping the individual as a contributing member of society. The United Nations Decade of Education for Sustainable Development was declared to emphasize the importance of education in increasing world sustainability in the period from 2005 to 2014 (Wals, 2014). The objective was to incorporate the principles, values, and methodologies of sustainable development across the wide spectrum of education and learning (UNESCO, 2014b) and create a sustainable future in terms of environmental efforts, economic viability, and an equitable society for both present and future generations (UNESCO, 2014a).

This paper addresses the different natures of applying proposed strategies and sustainable solutions and how they could be incorporated into education through real-life case studies. One of these case studies is 'Giza Zoo-Park,' and how to reinvade it was chosen to be discussed in this paper. The next part introduces the high potential of the park to be redeveloped as an urban catalyst.

1.3. Case Study: Giza Zoo Park

Giza Zoo Park has always been an iconic public space in modern Egyptian history. It is now marked as the nostalgic last vestige of greenery characterized as an agricultural hinterland in Cairo. Tourists choose to visit Egypt's well-known cultural and historical sites over the zoo (Battesti, 2006). Giza Zoo shows problems in the whole space discourse with fragile perspectives of sustainability strategic approaches.

Some literary reviews address the zoo public space typology, raising concerns about animal welfare (Ward et al., 2020) and preventing them from spreading diseases. More research worldwide is needed to resonate with the proposal of sustainable development approaches and design solutions to construct zoo parks. Public spaces maintain good physical and mental health, well-being, and social activities; a zoo park is a place where multiple groups can interact and congregate, giving more opportunities for social inclusion.

Giza Zoo Park was an initiative to be redeveloped by the students. They addressed sustainability challenges and related issues from social, environmental, wild-life protection, and economic dimensions. Students propose different scenarios to reimagine the zoo as a sustainable, inclusive space and social hub that can give longevity to animals and attract more people from different social classes and tourists to visit. The following section will present the methodology of the course and the associated teaching methods.

2. METHODOLOGY

The course aims to impart knowledge and develop skills about promoting sustainable approaches by constructing a comprehensive methodological strategy incorporating multiple teaching methods in architecture pedagogy. The intended learning outcomes of the course are mainly to:

- Apply a few competencies concerning environmental, economic, and social issues and the implications of development initiatives on human well-being.
- Interpret sustainability and sustainable development concepts and contemplate related topics.
- Transfer knowledge about promoting sustainable development to face issues like climate change, environmental degradation, and sustainable rating systems.
- Work with sustainable development indicators: human development index, GDP, etc.
- Raise awareness of urban resilience and nature-based solutions.
- Introduce social sustainability and reflect on its concepts.
- Raise the capabilities of critical review and how to present sustainability strategies and approaches.
- Introduce social sustainability.

The course structure comprises multiple teaching methods to achieve the aforementioned intended learning outcomes. First, lectures were given to the students to provide the main theoretical background, which spread throughout the semester. Students learned about the difference between sustainability and sustainable development, bringing up Rostow's development model, sustainability conceptual apparatus, and alternative development. Then, there was an introduction about sustainable development indicators and challenges, sustainability and resilience, indicators of resilience, and its traits, focusing on resilience challenges in coastal cities. Most of the teaching pedagogy of sustainable development does not stress the social dimension, which is a key pillar of social sustainability. There was a special emphasis on the topic of social sustainability with its emergent definitions, challenges, related socio-spatial relations, and indicators of social sustainability and its contributory factors related to multiple scales.

There are also supported guest speaker lectures from academics and practitioners in the course aimed at bringing the "Academic-industry linkages" collaboration value to the learning and teaching pedagogy. Students went to "Dar AlHandasah" smart village office buildings that earned LEED gold. They learned about environmental challenges, climate change actions, and international rating systems. The students also had a tour of the building and learned its operation system and how it is energy efficient, providing a healthy environment for its occupants. There was an additional guest speaker from Middle and North Africa (MENA) at the World Green Council Building who talked about the health and well-being rating system.

One of the other teaching methods in the course was a critical paper review about various sustainability topics. This helped students gain skills, such as raising questions, developing critical thinking abilities, and improving conceptual argumentation to explore solutions and their associated challenges. It also helps spread knowledge about different issues through class presentations and peer-to-peer discussions. Various class activities fostered a good learning environment through a collaborative culture between the students while retaining the theoretical base of sustainability. Case study selection

covered the last four weeks of the course, which was supported by introductory lectures according to the project workflow (see Figure 1).

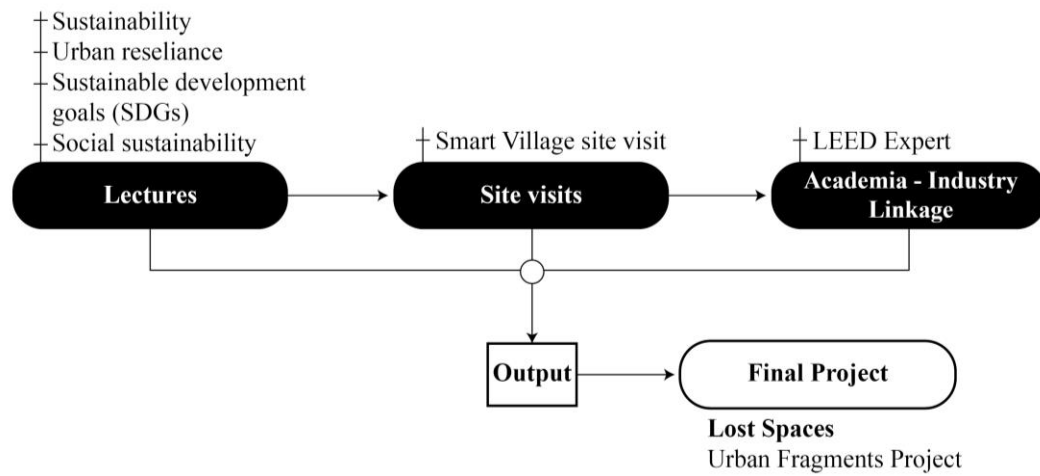


Figure 1 Course structure and its methodological approach. Source Authors

The project that has been presented to the students in the studio seeks to bridge the gap between theory, sustainable strategies, and applications, taking on-site case studies of 'lost spaces' as 'urban fragments' in the greater Cairo region. These urban spot locations were selected from each group (see Figure 2).

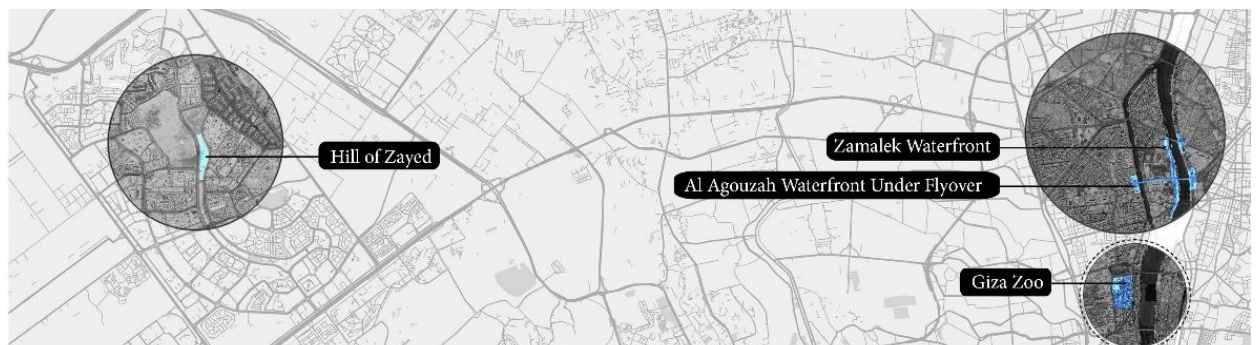


Figure 2 Urban Typologies in Cairo. Source Authors

Students outlined the potential and challenges associated with the issues of social equality, segregation, quality of life, etc. The whole discourse analysis of the project is divided into phases. Students first select an urban fragment to be re-imagined from the sustainable development approach. They should next choose similar case studies to their project typology, which is predefined; students can select between under flyovers, leftover space, parks, and waterfront public space. Students should analyze public spaces, considering the sustainable development approaches studied throughout the course. The students have expanded their knowledge about the urban resilience framework, sustainable development goals (SDGs), and sustainable strategies. The analysis should consider accessibility to the site, mobility, user groups, and functional opportunities there while addressing the economic, social, and environmental challenges. This analysis was tackled on both micro and macro scales and should be

induced to build upon the strategic approaches for sustainable development with convenient proposed design solutions (see Figure 3).

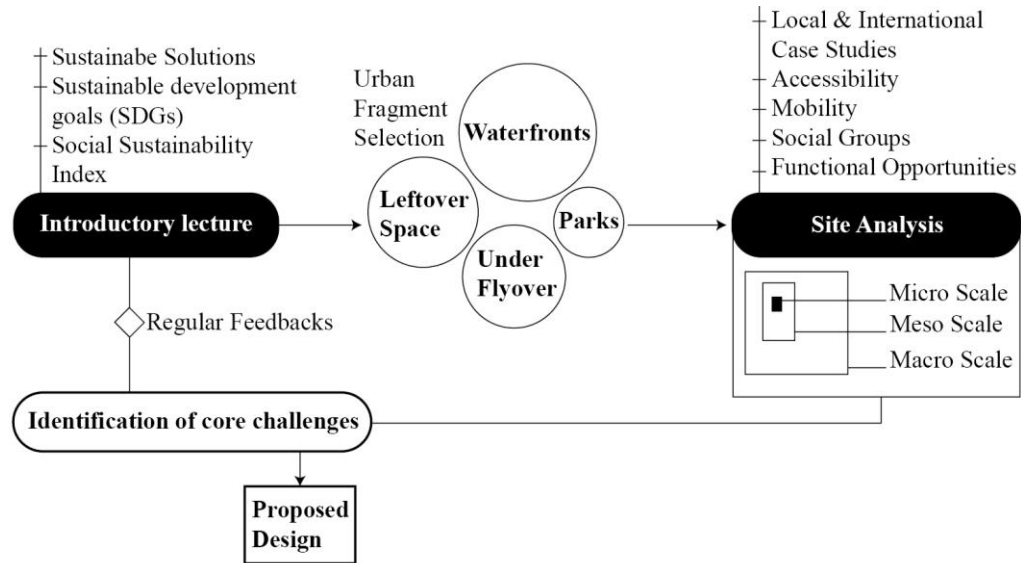


Figure 3 Project structure study Source: Authors

3. RESULTS AND DISCUSSION

‘Reimagining the Zoo’ is an exemplary project of sustainable urban public space design that reflects the different teaching methods and skills used. Giza Zoo is a strategic spot that was also chosen by Egypt’s Supreme Council for Planning and Urban Development (SCPUD), launching the renovation of the Zoo in 2023 to preserve the old trees and add more animal species. It is still under renovation.

Students highlighted first the issues related to social, environmental, economic, and wildlife protection, as seen in (Figure 4). After that, they analyzed the existing condition of the park. Many issues are related to the contaminated water lakes in the Zoo, and some green spaces are trash collection spots. There are also poor conditions in animal cages and their services, which affect the animal wildlife because of the poor nutrition and medical treatment. The ‘Citadel Grotto’ in the zoo is highly deteriorated. The Zoo should offer more services and amenities, which pose many environmental hazards and pollution problems. The levels of analysis were built upon these issues in different

aspects through the studies of buildings, services, social zones, routes, greenery, and water (see Figures 4 and 5).

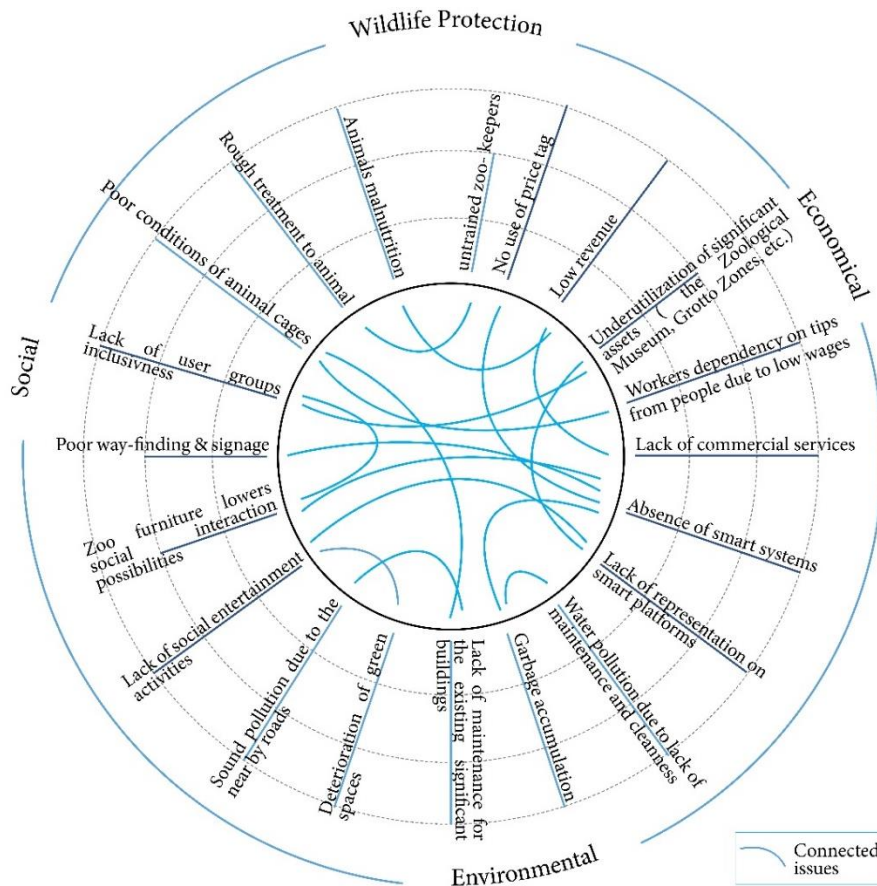


Figure 4 Zoo park main issues (source: Authors developed from studio work)

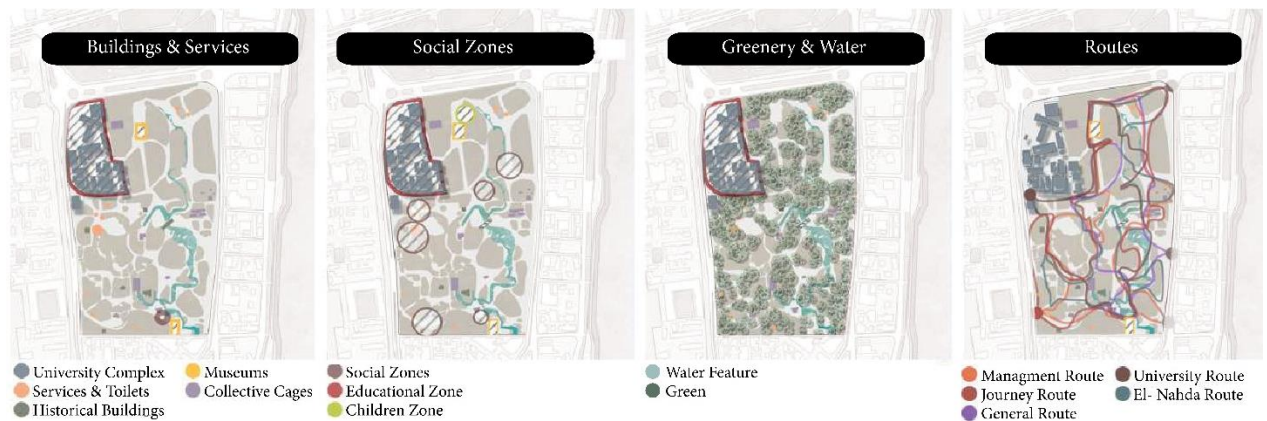


Figure 5 Analysis of the existing situation of the zoo (source: Authors developed from studio work)

There are different strategies proposed for zoo development using an integrative approach that is built upon different sustainability dimensions. These strategies addressed the social sustainability dimension; students stressed on public engagement through raising awareness of sustainable behaviour and suggesting social hubs. The environmental dimension was studied through waste diversion; it was useful to reuse the waste from animals and trees and conserve resources, such as water conservation and employing renewable energy resources. Moreover, enhancing wildlife is also an

important dimension contemplated with awareness campaigns for protectorates and animal care. The economic dimension focused on reviving revive commercial activities and utilize the park assets (see Figure 6).

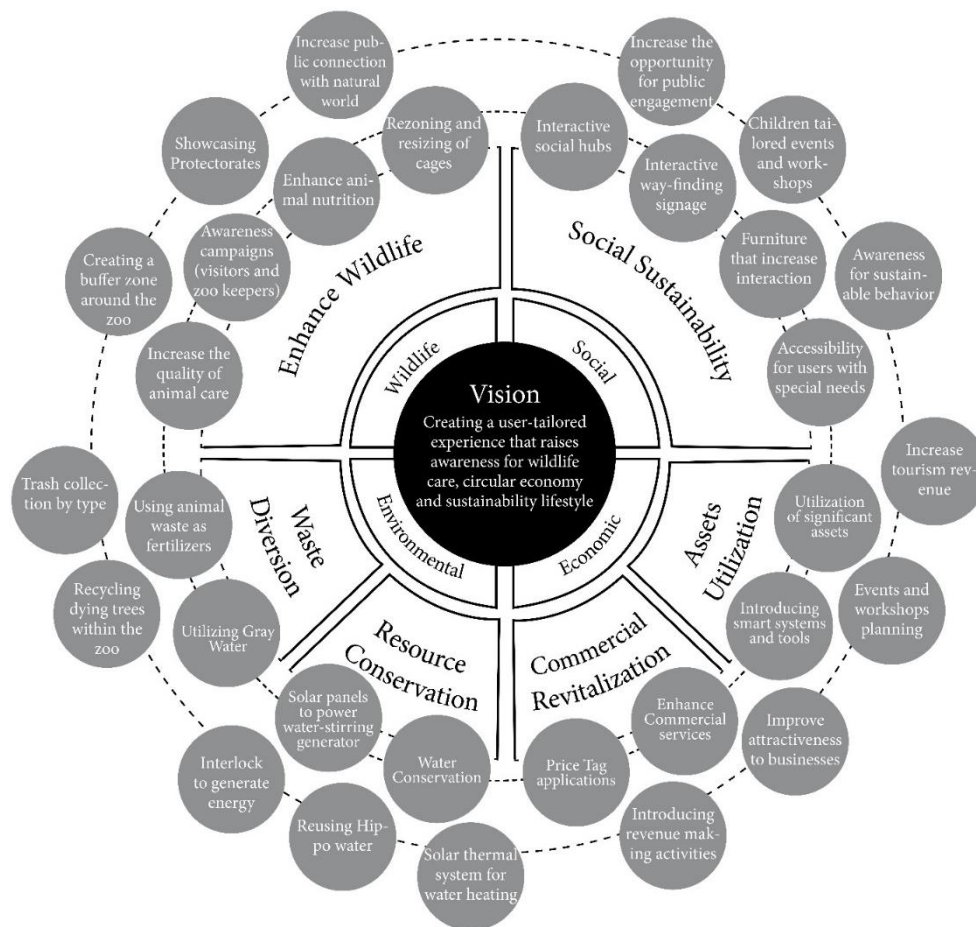


Figure 6 Zoo Park's proposed strategy for sustainable development (source: Authors developed from studio work)

The proposed sustainable solutions are linked to the main dimensions of the strategy to revitalize the zoo while preserving its most significant and distinctive historical features and considering contemporary worldwide standards. The proposed sustainable strategies were allocated based on the existing plan of the zoo park. An accessibility study was proposed to provide easy access solutions and achieve better circulation that could encourage the use of bikes and electric scooters in the zoo, giving opportunities for spontaneous social interaction. These modes of transport promote an active social environment that encourages people to stay in the park, where they are more likely to interact with each other. Reducing noise was suggested to provide a healthier animal environment. There were other studies on different sustainable options considering the land typologies and green areas and how to maximize their efficiency as social nodes that can attract people from different socio-economic groups. Water features are essential to provide a cleaner environment for the animals, while gray water could be recycled and trees could be planted inside the zoo. Students proposed repurposing the Grottos area to cohabitate with the animals while providing a better natural habitat and supporting biodiversity (see Figure 7).

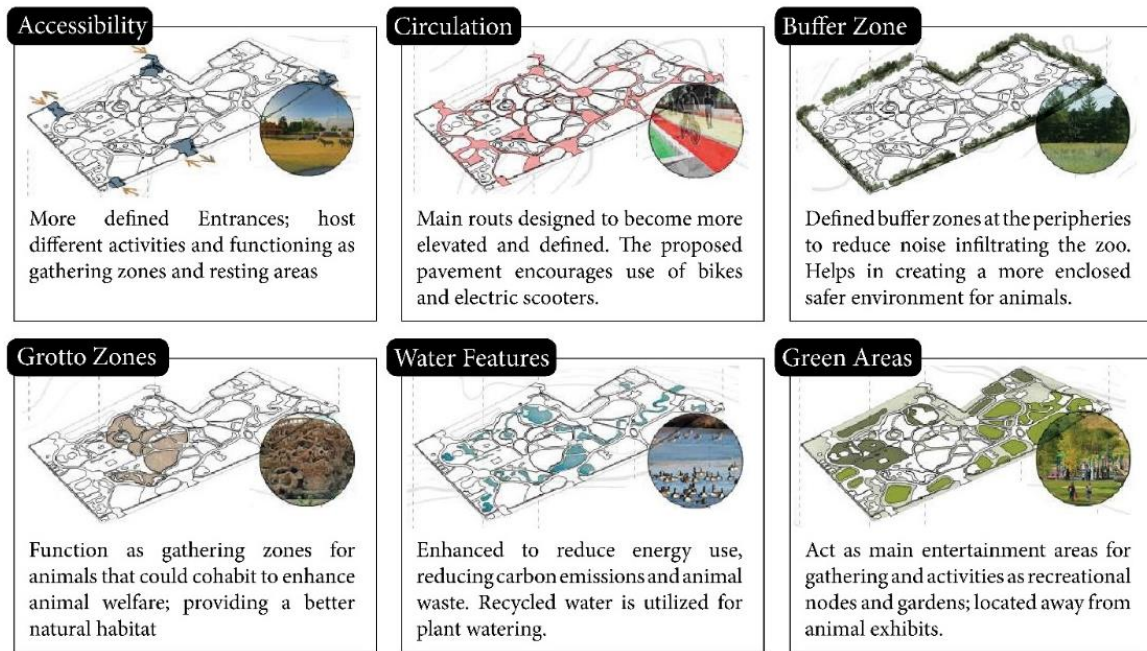


Figure 7 Implemented strategies. (source: Authors developed from studio work)

Using waste material for upcycling was a manageable solution in different ways; there was a suggestion of using the wood that comes from the abundant life of dead trees. For instance, this waste could be used to build a pavilion installation as a collective communal space in the zoo. Hippo water areas can be filtered and reused again to irrigate the trees there. Solar panels can be used to power the water pump. The initial master plan shows all imaginatively generated designs (see Figure 9).



Figure 8 Initial proposal of Zoo Park master plan (source: Authors developed from studio work)

Other sustainable solutions have been proposed, such as installing an 'Energy Interlock' in some parts of the zoo floor areas, which generates energy from the footsteps of park users. There was also a suggestion to use a 'Reverse Vending Machine' that enables users to insert recycled materials that can be collected and reused. This can engage more people for better sustainable behaviour that positively impacts the environment. Another idea is to mobilize quickly in the zoo using solar-charged electric scooters, which can improve the air quality and provide a pleasant walking environment in the park. Technological and smart devices like vending ticket machines and thermal security cameras are also used for surveillance purposes (see Figure 9).

The final project resonates with the knowledge, skills, and ability to develop appropriate sustainable solutions from a comprehensive perspective taught and discussed in the course. Students acknowledge the social, economic, and environmental benefits. The critical review assignment enabled them to develop their writing skills, critical thinking, and ability to determine what can be achieved in real life. They also gained valuable knowledge from the guest speakers and site visits, knowing the nature of the field studies and how the academic side is linked to the profession. This learning experience added to their knowledge and opened multiple horizons for career choices. The class activities and peer-to-peer review enabled the students to work in groups, increasing their communication skills and making them more efficient in presenting their work concisely. The final output, alongside the course work, highlighted the main aim of exploring different methods of integrating sustainability into architectural education and taking a step to fill the gap between theories of sustainability and its applications.

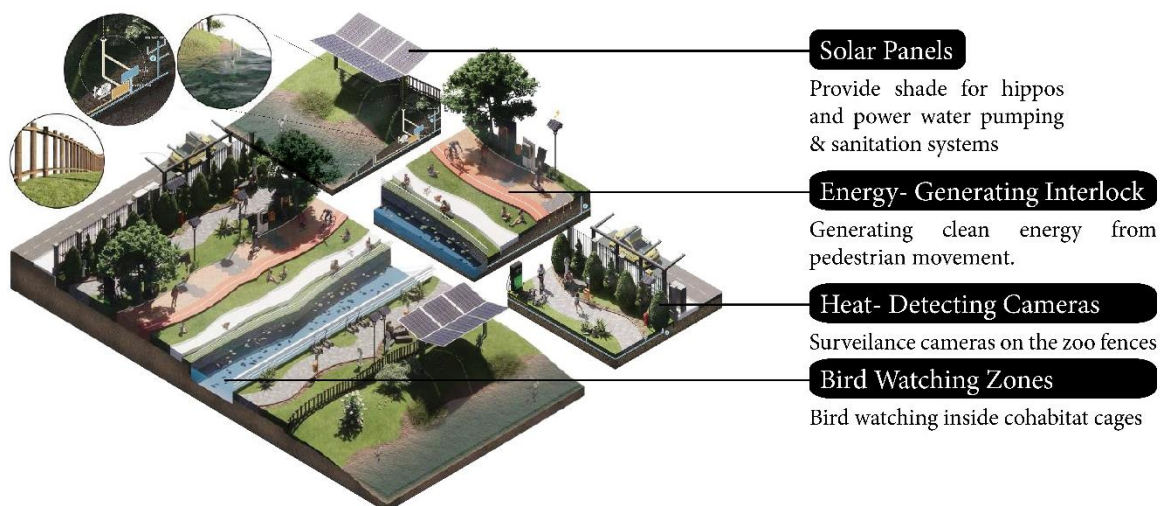


Figure 9 Zoo Park suggested sustainable interventions. (source: Authors developed from studio work)

4. CONCLUSION

This research discussed integrating sustainable development approaches and solutions into architecture and urban design programs. The research gap is tackled from a

comprehensive approach; therefore, the central contribution to this study is to investigate the theoretical and practical applications of sustainable development and understand the sustainability challenges and opportunities. The integrative teaching pedagogy presented in this paper showed the value of comprehensive methods in fostering deep understanding and achieving sustainable development goals. Furthermore, Giza Zoo, as one of the urban lost public spaces, demonstrates the potential of applying sustainable interventions that initially considered while designing parks and open spaces.

The aforementioned project was a four-week studio outcome, and there is a need for further research in the suggested proposal from designers and decision-makers to be taken into consideration similar case studies typology. The project requires more extended analysis that would enhance the depth of the study and depth and could elaborate the strategy development. Further studies on related topics, especially the implementation of zoo parks, may deliver diverse applications and investigate recent guidelines and international standards for achieving sustainable development that enhances the quality of life and biodiversity.

Furthermore, an interdisciplinary exchange of eco-system expertise among decision-makers causes economic benefits that could enhance sustainability. Finally, the approach chosen could be better developed in future studies with integrated research methods, such as questionnaires for the zoo's different groups and decision-makers to gather data on other obstacles and define possibilities that can be implemented successfully and for better assessment of the outcomes and project design evaluation. Further development of this teaching approach in similar fields and related topics could benefit embracing sustainability in architectural education. Despite limitations in this research, presenting the whole process is sufficient to bridge the gap between sustainable theories and how to narrow down the scope to reach appropriate smart and sustainable solutions that can impact the development of the architectural education domain.

Acknowledgement

The authors would like to recognize the work of the studio's students, with special thanks to Omar Saltah, Lama Mohamed, and Lamiaa Ahmed, who worked on the Reimagining The Giza Zoo project, which aided in the development of this paper's empirical part.

Disclosure statement

No potential conflict of interest was reported by the author(s)

References

1. Adegbile, M. (2012). Nigerian architectural education in a sustainable age. Sustainable Futures Conference: Kampala, Uganda - June 25 - 30, 2012. <http://www.sfc2012.org/papers.html>.
2. Altomonte, S. (2009). Environmental education for sustainable architecture. *Rev. Eur. Stud.* 1 (2), 12-21. <https://doi.org/10.5539/res.v1n2p12>
3. Altomonte, S., Cadima, P., Yannas, S., Herde, A., Riemer, H., Cangelli, E., Lopez-De-Asiain, M., & Horvath, S. (2012). Educate! Sustainable environmental design in architectural education and practice. In S. Lenzholzer (Ed.), *Proceedings PLEA 2012*. Lima, Perú.
4. Álvarez, S. P., Lee, K., Park, J., & Rieh, S. Y. (2016). A Comparative Study on Sustainability in Architectural Education in Asia - With a Focus on Professional Degree Curricula. *Sustainability*, 8(3), 290. <https://doi.org/10.3390/su8030290>
5. Battesti, V. (2006). The Giza Zoo: Re-Appropriating Public Spaces, reimagining urban beauty. In A. Paul & S. Diane (eds.), *Cairo Cosmopolitan: Politics, Culture, and Urban Space in the New Globalized Middle East* (pp.489-511). The American University in Cairo Press.
6. Benkari, N. (2013). The “sustainability” paradigm in architectural education in UAE. *Procedia - Social and Behavioral Sciences*, 102, 601–610. <https://doi.org/10.1016/j.sbspro.2013.10.777>
7. Boyer, E. L., & Mitgang, L. D. (1996). *Building Community: A New Future for Architecture Education and Practice*. Carnegie Foundation for the Advancement of Teaching.
8. Campos, P. (2020). Resilience, education and architecture: The proactive and “educational” dimensions of the spaces of formation. *International Journal of Disaster Risk Reduction*, 43, 101391. <https://doi.org/10.1016/j.ijdrr.2019.101391>
9. Dabaieh, M., El Mahdy, D., & Maguid, D. (2018). Living labs as a pedagogical teaching tool for green building design and construction in hot arid regions. *Archnet-IJAR: International Journal of Architectural Research*, 12(1), 338–355. <https://doi.org/10.26687/archnet-ijar.v12i1.1285>
10. De Gaulmyn, C., & Dupre, K. (2019). Teaching sustainable design in architecture education: Critical review of Easy Approach for Sustainable and Environmental Design (EASED). *Frontiers of Architectural Research*, 8(2), 238-260. <https://doi.org/10.1016/j.foar.2019.03.001>
11. Efthymios, V., Ioanna, P. A., & Iosif, F. (2009). A study on perceptions of open university students about the use of effectiveness of collaborative teaching methods during the tutorial group meetings. *Review of European Studies*, 1(2), 22. <https://doi.org/10.5539/res.v1n2p22>
12. El-Feki, S., & Kenawy, I. (2018). Integrating Sustainability within Architectural Education in Cairo. *Resourceedings*, 1(1), 33–41. <https://doi.org/10.21625/resourceedings.v1i1.183>.
13. European Parliament. (2010). Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the Energy Performance of Buildings. *Off. J. Eur. Union* 2010, 153, 13–35
14. Filho, W., Tripathi, S., Andrade Guerra, J. B., Gine, R., Orlovic Lovren, V., & Willats, J. (2018). Using the sustainable development goals towards a better understanding of sustainability challenges. *The International Journal of Sustainable Development and World Ecology*, 26(1), 1-12. <https://doi.org/10.1080/13504509.2018.1505674>
15. Gharib, M. S., Mikhael, M. G., & Aboushal, E. A. (2022). Inclusion of sustainability concepts in architectural education the current and expected situation in Egypt.

- Engineering Research Journal, 175(0), 336–351. <https://doi.org/10.21608/erj.2022.259425>
16. Gómez-Galán, J., Lázaro-Pérez, C., Martínez-López, J. Á., & López-Meneses, E. (2020). Measurement of the MOOC phenomenon by pre-service teachers: A descriptive case study. *Education Sciences*, 10(9), 215. <https://doi.org/10.3390/educsci10090215>
 17. Guadet, J., & Pascal, J.L. (1909). *Eléments et Théorie de L'architecture - Volume 1 (3rd ed)*. Paris, France: Librairie de la Construction Moderne.
 18. Hattan, A., Feder, J., Naik, A., Murphy, K., Davis, N., Esiet, U., Vithlani, K., & Rigaud, G. (2010). *Advancing Education for Sustainability: Teaching the Concepts of Sustainable Building to All Students: Second Nature and USGBC*
 19. Ismail, M. A., Keumala, N., & Dabdoob, R. M. (2017). Review on integrating sustainability knowledge into architectural education: Practice in the UK and the USA. *Journal of Cleaner Production*, 140(3), 1542-1552. <https://doi.org/10.1016/j.jclepro.2016.09.219>
 20. Iulo, L. D., Gorby, C., Poerschke, U., Kalisperis, L. N., & Woollen, M. (2013). Environmentally conscious design – educating future architects. *International Journal of Sustainability in Higher Education*, 14(4), 434–448. <https://doi.org/10.1108/IJSHE-09-2011-0065>
 21. Jamieson, C. (2011). *The future for Architects?* London: Royal Institute of British Architects.
 22. Karatepe, Y., Nese, S. V., Keçebas, A., & Yumurtaci, M. (2012). The levels of awareness about the renewable energy sources of university students in Turkey. *Renewable Energy*, 44, 174-179. <https://doi.org/10.1016/j.renene.2012.01.099>
 23. López, L. I., Bote, M., Rives, L. M., & Bañón, A. R. (2019). Higher education institutions as a transformation platform under the Sustainable Development Goals framework. *European Journal of Sustainable Development*, 8, 306–312. <https://doi.org/10.14207/ejsd.2019.v8n3p306>
 24. Mohamed, K. E. & Özkan, S. T. E. (2018). Sustainable architectural design education: A pilot study in a 3rd year studio. *The Academic Research Community publication*, 2(3), 126-135. <https://doi.org/10.21625/archive.v2i3.354>
 25. Olotuah, A. O. (2000) *Architect–Educators and the Curriculum in Architecture: Roles and Expectations in the 21st Century*. *AARCHES J.*, 1 (5), August, pp. 29–32.
 26. Rieh, S. Y. (2002). Survey on the Architectural Design Education in Korea from the View of International Education Criteria for Architecture - With Focus on the Studio Assignment of Schools in Seoul. *Journal of the Architectural Institute of Korea (Planning & Design)*, 164, 53–60
 27. Rieh, S.-Y., Lee, B.-Y., Oh, J.-G., Schuetze, T., Porras, S., Lee, K. S., & Park, J. (2017). Integration of Sustainability into Architectural Education at Accredited Korean Universities. *Sustainability*, 9(7), 1121. <https://doi.org/10.3390/su9071121>
 28. Salama, A., & Amir, A. (2005). *Paradigmatic Trends in Arab Architectural Education: Impacts and Challenges*. Paper Intended for Publication and Presentation at the International Congress of Architecture. The International Union of Architects-UIA: Istanbul, Turkey
 29. Shari, Z., & Jaafar, M. F. Z. (2006). Towards a Holistic Sustainable Architectural Education in Malaysia. *ALAM CIPTA International Journal of Sustainable Tropical Design Research and Practice*, 1, 57–64
 30. Siraj, S., & Ismail, A. S. (2018). The role of the architect as an educator in design education towards the development of a sustainable society: A case study of Hajeedar. *Advanced Science Letters*, 24(6), 4546–4549. <https://doi.org/10.1166/asl.2018.11651>

31. Sterling, S. (2001). Sustainable education: Re-visioning learning and change (Schumacher Briefing No. 6). Schumacher Society/Green Books.
32. Trachte, S., De Herde, A., López de Asiaín, M., Burgos, C. E., Altomonte, S., & Gobson, A. (2012). Sustainable Architectural Education (White Paper). Department of Architecture and Built Environment, University of Nottingham: Nottingham, UK.
33. UNESCO. (2014a). United Nations Educational, Scientific and Cultural Organization. Education for Sustainable Development. Retrieved from <http://www.unesco.org/new/en/education/themes/leadingthe-international-agenda/education-for-sustainable-development>
34. UNESCO. (2014b). Shaping the Future We Want - UN Decade of ESD What is Education for Sustainable Development (Final report). Retrieved from <https://sustainabledevelopment.un.org/index.php?page=view&type=400&nr=1682&menu=35#:~:text=The%20United%20Nations%20Decade%20of,a%20more%20sustainable%20and%20just>
35. UNESCO-UIA. (2002). *UNESCO-UIA validation system for architectural education*. International Union of Architects (UIA), Paris, France, p. 31.
36. Wals, A. E. J. (2014). Sustainability in higher education in the context of the UN DESD: A review of learning and institutionalisation processes. *Journal of Cleaner Production*, 62, 8–15. <https://doi.org/10.1016/j.jclepro.2013.06.007>
37. Ward, S. J., Williams, E., Groves, G., Marsh, S., & Morgan, D. (2020). Using Zoo Welfare Assessments to Identify Common Issues in Developing Country Zoos. *Animals*, 10(11), 2101. <https://doi.org/10.3390/ani10112101>
38. Wright, J. (2003). Introducing sustainability into the architecture curriculum in the United States. *International Journal of Sustainability in Higher Education*, 4(2), 100-105. <https://doi.org/10.1108/14676370310467131>
39. Žalėnienė, I., & Pereira, P. (2021). Higher Education for Sustainability: A Global Perspective. *Geography and Sustainability*, 2(2), 99–106. <https://doi.org/10.1016/j.geosus.2021.05.001>