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FOSTERING FUTURE ARCHITECTS: INTEGRATING SUSTAINABILITY AND PROFESSIONAL PRACTICE IN CURRICULUM REFORMS

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ABSTRACT

Architectural education is facing increasing challenges, particularly in the integration of sustainability principles and alignment with professional practice. This study investigates the current state of architectural education in Egypt, with a focus on the Department of Architecture at the Faculty of Fine Arts, Alexandria University. Using a mixed-methods approach—including surveys, interviews, and literature review—the research identifies key curricular gaps and systemic challenges. The findings highlight a notable disconnect between academic training and industry expectations, especially in sustainable design and practical competencies. Further issues include limited integration of social and environmental dimensions, outdated course content, and inadequately equipped laboratories that hinder experiential learning.

In response, the study proposes a comprehensive action plan for reform, emphasizing interdisciplinary learning, faculty development, industry collaboration, and pedagogical innovation. By cultivating "green competence," the proposed reforms aim to prepare graduates for sustainable development and align academic education with evolving professional demands. The action plan also advocates for upgrading infrastructure and enhancing community engagement, ultimately bridging the gap between academic theory and architectural practice in support of Egypt's sustainability goals.

KEYWORDS: Architectural Education, Sustainability, Curriculum Reform, Professional Practice, Interdisciplinary Learning

1. INTRODUCTION

Architectural education has evolved considerably over time to reflect shifting societal needs and professional standards. Initially centered on classical design principles and craftsmanship [1]. However, the field experienced a major transition during the 20th century with the rise of modernism, which emphasized functionalism and technological advancement. The importance of sustainability within architectural curricula emerged prominently following the 1987 report by the World Commission on Environment and Development [2]. which underscored the imperative of sustainable development. Subsequent global initiatives, such as the Higher Education Sustainability Initiative (HESI) and the United Nations Sustainable Development Goals (SDGs), have further reinforced the critical role of higher education institutions in advancing sustainability [3]

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While “sustainability” is common in design studio briefs, there is a lack of clear definitions and practical strategies for students. Studies have identified gaps between academic knowledge and professional practice, as well as between social and technical knowledge [4]. While the building sector has a significant contribution to global energy consumption and emissions, it underscores the urgency of incorporating sustainability into architectural education. However, many architecture schools have not fully integrated sustainability, often limiting it to elective courses or individual initiatives[5]. Challenges include ambiguous definitions of sustainability, lack of expertise, and resistance to curriculum changes[6].
As architectural education in Egypt increasingly turns toward sustainability, several European models offer valuable insights. The University of Auckland incorporates sustainability through dedicated courses and design studios, while the University of Texas at San Antonio offers it as an elective topic with limited integration in design studios. In contrast, Cardenal Herrera University embeds sustainability across the curriculum, particularly in design studios [2]. These examples highlight the need for a more comprehensive and integrated approach to sustainability education.

Among the most prominent examples are the Urban Living Lab Center (ULLC) at TU Berlin which provides a comprehensive, interdisciplinary learning environment combining academic instruction, applied research, and community engagement. Its pedagogical model is structured around seven pillars: skill development, experiential learning, workforce readiness, interdisciplinary collaboration, research integration, long-term impact, and stakeholder networking. Students are immersed in real-world projects, often working alongside industry experts and community actors. This format fosters practical competencies, critical systems thinking, and direct exposure to sustainability challenges in urban contexts [7], [8]. The ULLC emphasizes hands-on learning which can be especially relevant for institutions aiming to prepare students for Egypt’s urban development challenges.

Similarly, Chalmers University of Technology exemplifies how institutional alignment can enhance sustainability of education. The university’s master program, Architecture and Planning Beyond Sustainability, is embedded within a campus-wide agenda that mandates environmental integration across departments. This is through the HSB Living Lab, which is a collaboration project between Chalmers and 11 other partners in the built environment sector. This Living Lab is a residential building with 29 apartments to help students to examine the Sustainable housing of the future [9]. The top-down policy of Chalmers University ensures that sustainability is not a niche topic but a core principle across all tracks, influencing both course, content, and faculty development [8], [9].

This model demonstrates the effectiveness of aligning curricular design, institutional policy, and staff training. Integrating these insights into the Egyptian context can strengthen efforts to align architectural education with both local challenges and global sustainability goals, particularly through lab-centered reforms and a shift toward participatory and challenge-based learning models.

The gap between architectural education and professional practice is widely acknowledged. Scholars such as Daniel Libeskind and Bill Grubich have criticised the disconnect between what is taught in academia and the realities of professional practice [11]. This gap is impaired by outdated curricula, insufficient practical training, and a lack of alignment with industry standards [4]. Practical training and community engagement are crucial for producing competent architects. Case studies such as the Ponticelli SmartLab and LAC-Climate Action Lab Naples demonstrate the effectiveness of service-learning and public engagement in bridging the gap between academia and practice [12]. Similarly, the Design-build Reclaiming Heritage initiative engages students in post-disaster reconstruction, providing hands-on experience and fostering collaboration with industry professionals.

Further bridging academia and professional practice, integrating well-established educational theories into architectural education can significantly enhance the learning experience. Constructivism, as posited by Piaget and Vygotsky, supports the use of design studios and project-based learning, where students engage in hands-on activities that mirror real-world challenges [13][14]. Kolb's Experiential Learning Theory advocates for a returning process of concrete experience, reflective observation, abstract conceptualisation, and active experimentation, that particularly relevant in architecture [14].

Humanistic education theories, championed by Maslow and Rogers, focus on the holistic development of the individual, promoting self-actualisation and personal growth. This can be achieved through personalised learning plans and mentorship programmes [13]. Connectivism, proposed by Siemens, highlights the importance of networks and connections in the digital age, facilitating collaboration and knowledge sharing among students, educators, and industry professionals [15]. Innovative pedagogical approaches, such as Problem-Based Learning (PBL) and Situated Learning Theory, further enhance architectural education. PBL emphasises learning through solving open-ended problems, encouraging self-directed learning and critical thinking. Situated Learning Theory supports the creation of learning environments that mimic real-world practice, such as collaborative projects with industry partners and community-based design projects [13].

The acquisition of 21st-century skills is pivotal in the realm of architectural education, as they furnish students with the competencies requisite for navigating the ever-evolving architectural milieu. These skills can be identified as green competence needed to be involved in the future education. The skills are compartmentalized into three principal domains: Cognitive Competencies, Interpersonal Proficiencies, and Intrapersonal Abilities as illustrated in Figure 1 [16].

Additionally, innovation skills foster creativity and risk assessment, while digital literacy skills enhance design capabilities and efficiency. These skills are foundational, preparing students for the complexities of the profession and enhancing employability[16]. They are, therefore, a cornerstone of a robust architectural curriculum.

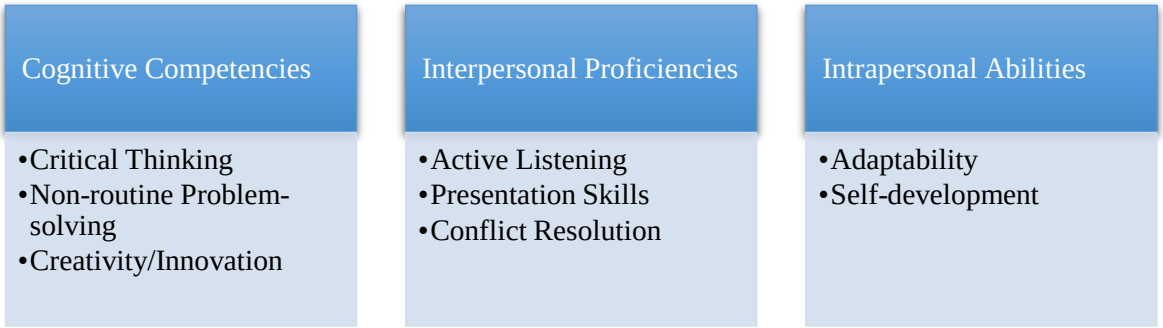


Figure 1: 21st Century competences [16]

2. METHODOLOGY

This study employed a mixed methods approach to investigate the current state of architectural education in Egypt, with a specific focus on the Department of Architecture at the Faculty of Fine Arts, Alexandria University (AU). The literature review was conducted to explore the gap between architectural education and professional practice, emphasizing local and global contexts.

To gather comprehensive data, an analysis of the architecture department's course syllabus to assess its alignment with sustainability principles, industry requirements, and professional practice standards. Additionally, online surveys were distributed to students, staff, and alumni to collect quantitative data regarding their experiences, perceptions, and suggestions. In-depth interviews with industry professionals were also conducted to obtain qualitative data, offering practical insights into

the skills and competencies required in the workforce to identify critical gaps between academic training and professional demands.

The collected data underwent in-depth analysis using both statistical and thematic techniques. Quantitative data from the surveys was analysed statistically to identify trends and patterns, while qualitative data from the interviews was examined thematically to extract key themes and insights.

3. CURRENT AU CURRICULUM

The Department of Architecture at the Faculty of Fine Arts at AU offers a comprehensive program that spans five years or ten semesters. This program does not include academic majors but instead comprises various course packages. These packages are grouped based on their shared goals, the nature of their content, and their potential for employment. The curriculum is divided into nine primary categories: Architecture Design, Building Construction and Working Drawings, Urban Design and Planning, Project Management, Computer Software and 3-D Modelling, History and Theories of Architecture, Environmental Design and Sustainability, Building Engineering, and Arts.

Table 1 provides a detailed breakdown of the courses offered in each category, along with the corresponding credit hours. For instance, 'Architecture Design' has 10 courses with 112 credit hours, indicating a substantial emphasis on this area within the curriculum compared to others like 'Urban Design and Planning,' reflecting an educational approach that prioritizes depth in certain key areas over breadth across many fields.

Table 1: Courses Packages NUMBER AND CREDIT HOURS

	SUBJECTS CATEGORIES	COURSES		CREDIT HOURS	
		Number	%	Number	%
1	Architecture design	10	16%	112	40%
2	Building construction and working drawings	11	18%	52	18%
3	Urban Design and Planning	4	7%	18	6%
4	Project management	5	8%	10	4%
5	Computer software and 3-D modelling	2	3%	8	3%
6	History and theories of architecture	10	16%	21	7%
7	Environmental design and sustainability	1	2%	2	1%
8	Building Engineering	11	18%	34	12%
9	Arts	7	11%	26	9%
	TOTAL:	61		283	

The table also underscores the importance of the 'Building Construction' and 'Engineering' packages in the curriculum. Conversely, less emphasis is placed on 'Environmental Architecture' and 'Computer Software' courses. It's noteworthy that the curriculum includes only one course specifically dedicated to sustainability, with efforts being made to integrate its application into a design studio course. This integration not only encourages students to self-learn modelling and simulation software within the context of design studios but also fosters an understanding of sustainability principles in a practical, real-world setting. But on the other hand, this percentage for sustainable architecture is not enough to make a deep learning to students (Figure 2). This approach reflects the department's commitment to fostering a comprehensive, conscious about learning environment.

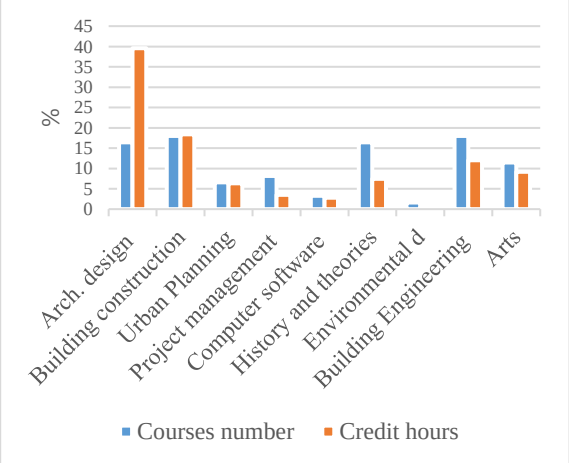


Figure 2: courses Package Percentage in AU Architecture Department

4. DATA COLLECTION AND ANALYSIS

Data was collected through online surveys distributed via office forms to students (43 responses), staff (11 responses), and alumni (22 responses) within the architecture department of the Faculty of Fine Arts. Figure 3 shows the academic levels and professional experiences for different surveys. Additionally, six interviews were conducted with various local and international industry professionals to ascertain the requirements for both local and global markets and the employment of architects. The discussion will encompass four key aspects: Education, Social Needs, Market, and Laboratories. Each aspect will be examined from multiple perspectives, including those of students, staff, alumni, and industry professionals, in parallel.

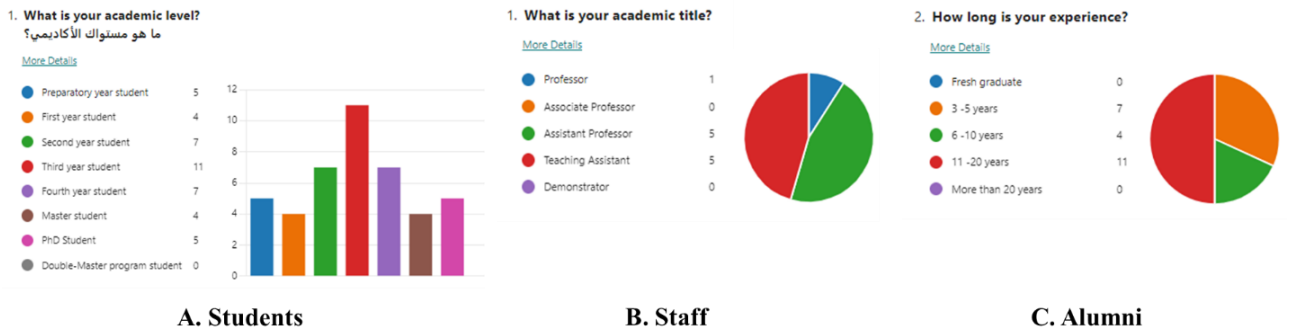


Figure 3: Survey respondent's academic and professional background

4.1. Educational Needs Assessment

When inquiring about the fields of interest in architectural education among students and staff, most responses indicated a preference for Architectural Design, with interest percentages of 31% for students and 27% for staff. This was followed by Urban Design, with 14% of students and 21% of staff expressing interest. Urban Planning was the least favoured, with only 8% of students and 6% of staff showing interest, as shown in Figure 4.

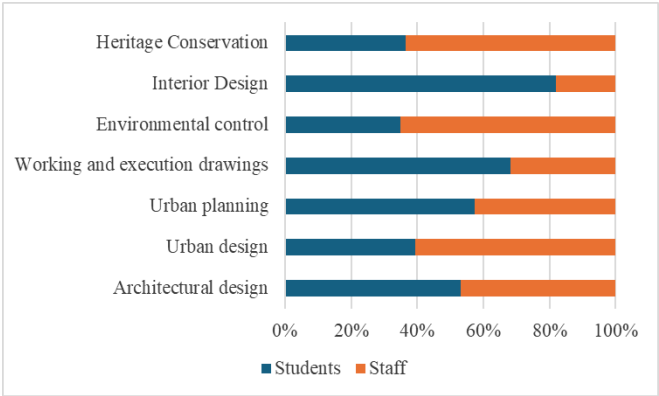


Figure 4: Students and staff interesting fields

A notable discrepancy was observed in the interest levels for Environmental Architecture, with 15% of academic staff showing interest compared to only 8% of students (Figure 4). This disparity can be attributed to the limited availability of environmental courses, with only one course offered at the undergraduate level, and the lack of integration of environmental concepts in the design studio.

Conversely, students demonstrated significant interest in Interior Design and Execution Drawings, with 14% and 13% respectively, while only 3% and 6% of academic staff shared these interests (Figure 4). It is important to note that the Working and Execution Drawing course package is the second priority in the department's curriculum. These findings highlight the need to enhance the capabilities of academic staff in Working and Execution Drawing and Interior Design, as well as to increase the number of courses in Environmental Architecture to leverage the expertise of the staff in this field.

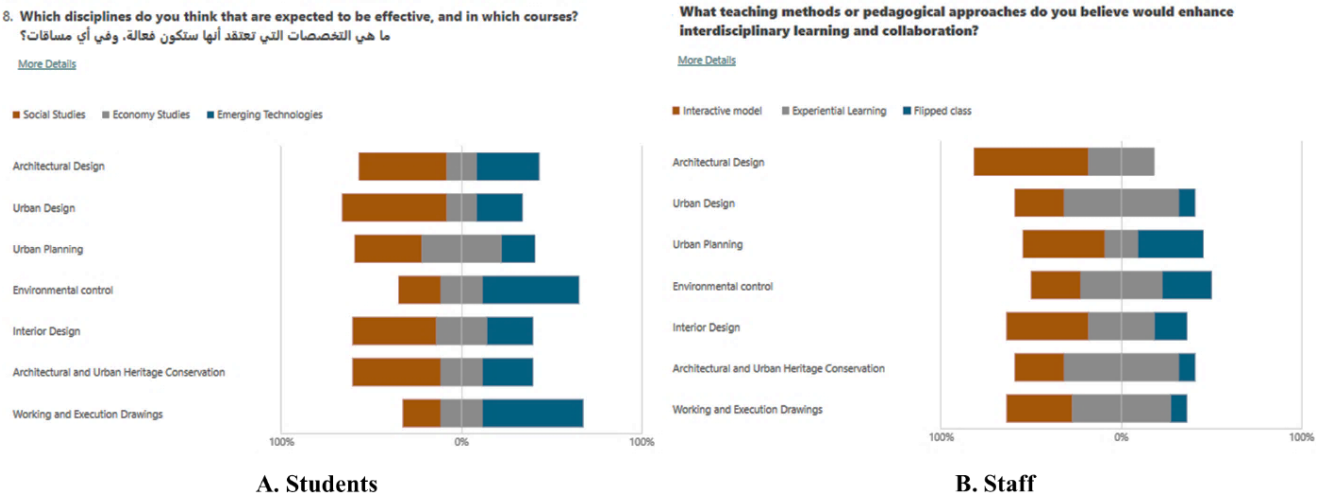
Sustainable Development is a holistic approach that considers the social, environmental, and economic impacts of current actions and decisions. There is significant interest in integrating this concept into architectural education. Most students (42%) find the courses in the department moderately relevant to the concept, while 55% of the staff find the courses only slightly relevant.

Students identify the environmental course as the most engaging in terms of sustainable development, followed by design studios (Figure 4).

Staff emphasized the importance of studying sustainable development goals and linking them with applications in various courses. They also highlighted the need for an in-depth study of climate change and sustainable techniques in design and construction. Additionally, they stressed the importance of community engagement making societal-driven design decisions and designing for humans.

77% of alumni are between moderately and slightly satisfactory with their overall educational experience in terms of sustainable development, which helps 72% of them to be hired by organizations that are been involved in sustainable urban development.

The integration of interdisciplinary education within architectural curricula is increasingly recognized as essential for preparing students to address the multifaceted challenges of contemporary architectural practice. The survey of architecture students (Figure 5-A) highlighted the necessity of incorporating social studies across various courses to enhance their understanding of societal impacts on design. Additionally, students emphasized the importance of integrating advanced technologies in environmental and working drawing courses, as well as incorporating economic aspects into urban planning and project management courses.
Faculty-staff discussions underscored the need for diverse teaching methodologies (Figure 5-B), particularly advocating for experiential learning methods to connect students with societal needs and real-world scenarios. Interactive models are predominantly applied in design courses such as architectural design, urban planning, and execution drawings, fostering a collaborative learning environment. Furthermore, the flipped classroom model was identified as suitable for theoretical content, although its implementation is challenging in large classes exceeding 250 students. This comprehensive approach to interdisciplinary education aims to equip architecture students with the necessary skills and knowledge to navigate and contribute effectively to the complex, interdisciplinary nature of modern architectural practice.



A. Students **B. Staff**

Figure 5: Students and Staff Opinions on Interdisciplinary Courses and Teaching Methods

From the students' perspective, there are several specific subjects and skills they find missing in their current curriculum that could enhance their career goals. These include the relationship between architecture and economy, sustainable studies, social and philosophy studies, and urban planning. Students also highlighted the need for parametric design, understanding the effect of space geometry on sound and light, and more subjects like architectural theories focusing on philosophical topics. Additionally, they emphasized the importance of keeping up with software technology, including 3D modelling and BIM courses, and the need for practical applications such as internships and real-life site visits. Other areas of interest include interior design, artificial intelligence, and the integration of

GIS and advanced computer courses. Students also expressed a desire for curricula that are more closely linked to global issues like economics and climate change, and for training that prepares them for the market.

4.2. Laboratory Needs Assessment

The Architecture Department currently boasts two laboratories. The first is a GIS lab, which is still under experimentation and in the process of becoming fully operational. This lab is equipped with environmental measurement devices, including three data loggers, a thermal camera, a solar radiation device, a 4-in-1 environment meter, and a 360-degree camera. The second laboratory, recently opened, is dedicated to CNC and 3D printing. At present, the labs' activities are primarily limited to workshops and postgraduate activities, with undergraduate access restricted, particularly for those using computers for 2D and 3D courses. As a result, 70% of the students have never used the labs, and 64% of the staff reported rare usage. These issues significantly limit the labs' potential as valuable resources for both students and staff. These challenges include:

- limited space,
- insufficient equipment and software,
- the absence of courses to teach its use,
- rigid operating hours,
- poor internet connectivity,
- lack of activities and workshops.

From both students' and staff's perspectives, several key pieces of equipment and software are needed to enhance the functionality of the architecture department's laboratory. Students frequently mentioned the need for more computers and advanced technical instruments, including devices for measuring light and sound analysis. They also highlighted the importance of having access to up-to-date software such as Revit and AutoCAD tools, which are essential for modern architectural design and planning.

Staff members echoed these needs, emphasizing the necessity for advanced equipment like laser cutters, 3D printers, CNC machines, and environmental testing equipment for lighting, acoustics, and thermal comfort. They also pointed out the need for licenses, including BIM tools like Revit, urban design and planning software, and photogrammetry software. Additionally, staff highlighted the importance of having reliable internet access and portable projectors to facilitate teaching and research activities. Addressing these equipment and software needs is crucial for improving the lab's capabilities and supporting both educational and research activities within the department.

4.3. Societal Needs Assessment

The societal aspect and community engagement are integral to the study of architecture. Assessing societal needs and integrating community engagement into academic teaching is crucial. Encouraging students and staff to interact with societal activities fosters a deeper understanding of the social, cultural, and environmental contexts in which they will practice. The departments have different practices such as field trips, national and international workshops for students to integrate with case studies addressing various community problems. Furthermore, the practice of the graduation project in the fourth year allows students to study the urban planning, design, and architecture of certain governorates in Egypt. This enables them to understand social behaviour and needs, and to select their graduation project based on a real need.

Analysing survey responses from students and staff reveals a mixed perception of institutional efforts in this regard. AS illustrated in Figure 6, most students (51%) feel that their institution strongly encourages community engagement and social responsibility, while 45% of staff share this sentiment.

However, there is a notable gap in the perceived relevance of assignments to local societal needs, with only 26% of students finding them very relevant compared to 55% of staff who believe the curriculum addresses pressing social and environmental challenges effectively (Figure 6). This discrepancy highlights the need for academic institutions to better align their educational content with

local societal needs, ensuring that students are equipped with the skills and knowledge to address contemporary issues in architecture. By fostering stronger community ties and integrating real world challenges into the curriculum, institutions can enhance educational experience and prepare students to contribute meaningfully to society.

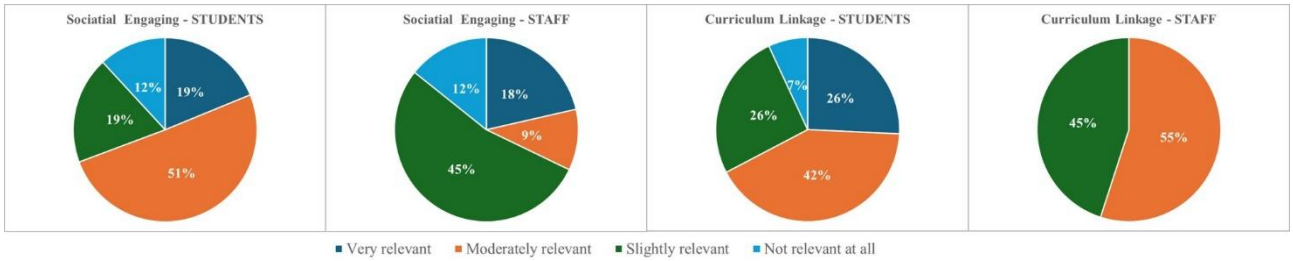


Figure 6: Pie Charts of Society Engagement in Academic Study

Incorporating social and environmental issues into the architectural curriculum is essential for fostering a holistic and responsive educational framework. Staff responses highlight several critical areas requiring attention. Their suggestions extend to Social Issues - Environmental Issues, and Holistic Approaches.

Table 2 illustrates the discussed sub-topics. Addressing these issues within the curriculum will enhance students' understanding of their societal and environmental impact and prepare them to contribute effectively to sustainable urban development and social equity.

Table 2: the suggested integrated topics in the curriculum

Social	Affordable housing
	Urban renewal and public spaces
	Accessibility and social equity
	Cultural heritage preservation
	Community-based design initiatives
	Collaboration with locals, NGOs, and authorities
Enviromental	Climate change mitigation
	Sustainable design
	Sea level rise and coastal protection
	Waste management & resource recovery
	Urban heat island effect
	Sustainable energy sources
	Natural ventilation and passive design
	Green architecture and biomimicry
Holistic Approach	Life cycle assessment (LCA)
	Biophilic design
	Green building rating systems
	Practical training
	Linking market to academic programs
	Fostering critical thinking and problem-solving skills

4.4. Market Need Assessment

The integration of market needs into educational qualifications is essential for preparing students to enter the job market. For Egyptian architects, the market is segmented into three primary categories: local, Gulf area, and European and American markets. While all sectors require common knowledge and skills, specific requirements vary by country, the level of hiring architectural firms, and the job's position and specialization.

A survey of staff regarding the alignment of courses with market and industry needs revealed that 68% perceive a weak connection, whereas 46% of students believe the connectivity is moderately well (Figure 7). Alumni satisfaction with the overall educational experience ranges from moderate to very satisfied at 64%. This suggests a lack of appreciation among faculty members for the quality of the courses and their relevance to the job market, potentially due to their ability to develop curricula and provide better and more realistic educational qualities, hindered by existing obstacles.

Furthermore, students rate the connections between the institution and architectural industry partners as moderate (44%) to weak (23%), as depicted in Figure 7-B. Additionally, their satisfaction with their educational experience, shown in Figure 7-A, fluctuates between satisfied (42%) and neutral (40%). This indicates that while the education process is on the right track, continuous improvement is necessary.

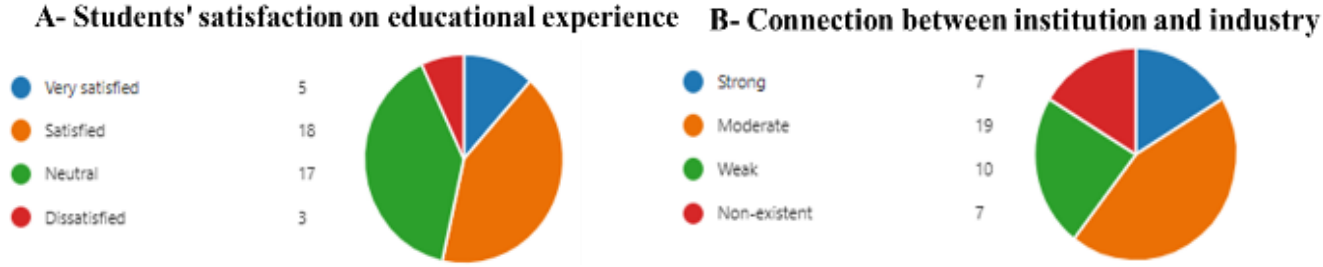


Figure 7: Students' satisfaction for education and connectivity with industry

Alumni and students agreed on evaluating the quality of courses related to the job market in Figure 8. Architectural design, construction and executive drawing, and interior design subjects were rated highly. In contrast, courses like environmental design were ranked lower by both students and graduates (Figure 9). This may be due to the limited effectiveness of the subject, as it is taught as a single course over five years with moderate activation in a design studio. It requires more attention. Graduates' selection of its lack of importance is attributed to the limited focus on environmental aspects in local projects within the Egyptian market, highlighting the need to emphasize the social and economic dimensions in the study of environmental architecture.

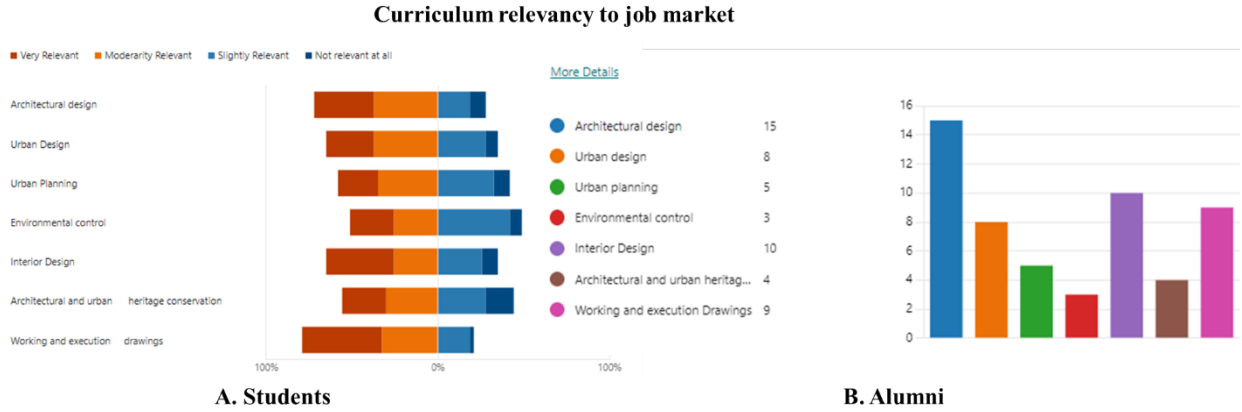


Figure 8: Curriculum relevancy to job market charts

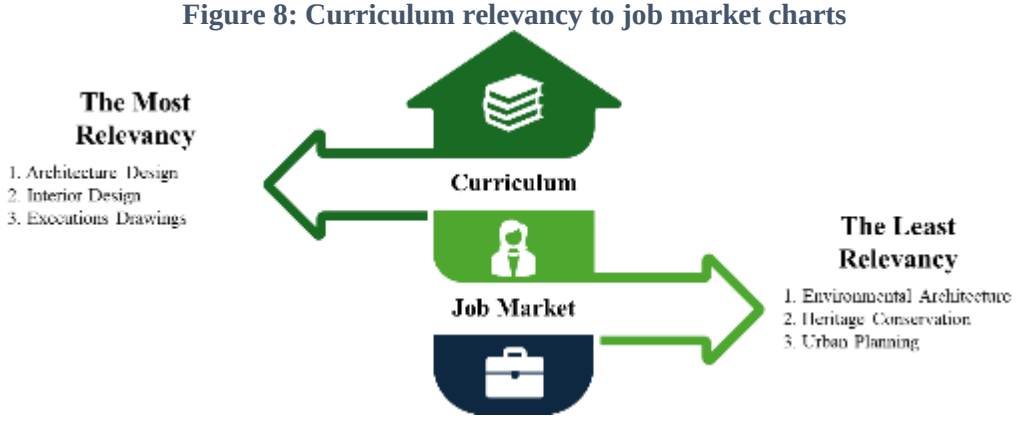


Figure 9: the most and least Curriculum relevancy to the job market

From the perspectives of students, staff, and alumni, several key areas for improvement have been identified in the linkage between architectural education and market needs. Students emphasize the need for a balanced curriculum that integrates practical applications with theoretical knowledge. They suggest enhancing the curriculum with more hands-on practice, current technologies, and opportunities for alignment with the market. Additionally, students highlight the importance of

improving teaching methods, encouraging creative project direction, and providing better facilities, such as labs and libraries.

Alumni focus on bridging the gap between academia and the market by incorporating practical skills, proficiency in industry-specific software, and project management skills into the curriculum. They also stress the importance of soft skills, management skills, and strategic thinking to better prepare students for the job market. Alumni suggest increasing internship programs, guest lectures, workshops, and joint research projects to provide students with real-world experience and exposure to the market.

Staff members advocate for the integration of advanced technologies, such as AI and sustainable urban planning, into the curriculum. They emphasize the need to bridge the gap between theory and practice, strengthen the focus on social, economic, and environmental aspects, and enhance alignment with the industry and career preparation. Staff also recommend developing the educational environment and spatial capabilities, fostering connections with industry, and hosting networking events to connect students with professionals.

4.5. Insights from Industry Professionals

Interviews with industry professionals reveal both strengths and weaknesses in the current architectural education system. The quality of education, particularly in design and artistic aspects, is praised, but there's a call for more emphasis on 21st-century skills, and insufficient understanding of the architectural design process's phases. There are many key insights that can be considered, as:

- **Need for Practical Experience:** Industry professionals emphasize the need for more practical application across all courses. This includes hands-on training in construction techniques, project management, software applications, and real-world projects.
- **Importance of 21st Century Skills:** There's a call for more emphasis on 21st-century skills, including strong communication, collaboration, problem-solving skills, and a global mindset.
- **Alignment with Market Needs:** The curriculum needs to be more closely aligned with the specific demands of the architectural job market, both locally and internationally. This includes understanding different project types, regulations, emerging trends, and the architectural design process's phases.
- **Strengthening Laboratory Infrastructure:** Professionals propose several enhancements for laboratory practices. They advocate for the augmentation of software courses with market-demanded skills such as digital sketching, landscape design, Navisworks, and the inclusion of advanced topics like energy performance simulation and feasibility studies.
- **Importance of GIS in Urban Planning:** The importance of Geographic Information Systems (GIS) in urban planning and city utilities management is emphasized.
- **Establishment of Certified Laboratories:** There is a call for the establishment of certified laboratories capable of providing accredited analysis or measurements in various specialized architectural fields.
- **Understanding Building Physics:** Understanding building physics and sustainable development is crucial for sustainable and efficient design decisions.
- **Overall Improvement Plan:** The improvement plan for architectural education should focus on creating a balanced and relevant curriculum that integrates practical applications, advanced technologies, and alignment with the market. Strengthening collaboration between industry and academia, enhancing teaching methods, and providing better facilities will ensure that graduates are well-prepared to meet the demands of the job market and contribute to societal and environmental sustainability.

Overall, the improvement plan for architectural education should focus on creating a balanced and relevant curriculum that integrates practical applications, advanced technologies, and alignment with the market. Strengthening collaboration between industry and academia, enhancing teaching methods, and providing better facilities will ensure that graduates are well-prepared to meet the demands of the job market and contribute to societal and environmental sustainability.

5. ACTION PLAN

The study identified several challenges that deter the effectiveness of architectural education in AU, Egypt. There is a significant gap between the skills and knowledge imparted in educational programs and the demands of professional practice, leading to graduates who often lack practical skills, experience, and essential soft skills such as communication, leadership, and ethical practices. Despite the growing importance of sustainable architecture, the current curriculum lacks sufficient depth in sustainable design principles and practices. Additionally, the content of architectural education often fails to align with current professional practice regulations and industry needs. The curriculum also has limited integration of the social and environmental dimensions of architecture, failing to equip graduates to address the complexities of sustainable urban development. Furthermore, the availability of well-equipped laboratories and access to cutting-edge technology is limited, hindering hands-on learning experiences and research opportunities.

While there are efforts to incorporate social responsibility, there is a disconnect between students' perception of their institution's commitment to community engagement and the perceived relevance of assignments to local societal needs. The primary gap identified is the disconnect between academic theory and professional practice, which is further aggravated by the lack of integration of sustainability principles, social responsibility, and contemporary technological advancements into the curriculum. In the light of these with the European Universities' sustainable integration in education, Table 3 shows a comparative analysis between AU and European Universities.

Table 3: Architectural Sustainability Education dimensions between AU and European Universities

DIMENSION	AU, EGYPT	EUROPEAN UNIVERSITIES
Curriculum Orientation	Fragmented, sustainability taught in isolated courses	Integrated, cross-curricular sustainability focuses across all modules and programs (e.g., Chalmers)
Faculty Capacity in Sustainability	Varies greatly; often depends on individual staff enthusiasm rather than institutional support	Institutional policies mandate environmental literacy; faculty upskilling prioritized
Learning Approach	Predominantly theoretical; limited active or experiential learning	Strong emphasis on experiential, challenge-based, and interdisciplinary learning (e.g., TU Berlin's ULLC)
Infrastructure and Labs	Under-resourced labs with outdated equipment; lack of interactive or interdisciplinary spaces	Labs as innovation hubs blending research, teaching, and stakeholder engagement (e.g., LABORA at POLIMI, HSB Lab at Chalmers)
Community Engagement	Minimal community involvement; limited external collaboration	Civic participation and stakeholder integration central to lab pedagogy (e.g., Medellín–Berlin Lab)
Green Competencies	Not explicitly defined in curricula, with partial focus on systems thinking	Explicit focus on systems thinking, climate literacy, interdisciplinary design, evidence-based decisions
Pedagogical Innovation	Limited pedagogical training or experimentation	Regular experimentation and research-led teaching frameworks (e.g., Urban Living Lab)

To enhance the effectiveness of architectural education in AU, a comprehensive action plan is developed in Table 4 with specific actions outlining the steps necessary to achieve these goals:

Table 4: Action Plan Matrix for Enhancing Architectural Education in AU

	ACTION	STAKEHOLDERS	SHORTCOMINGS
1	**Curriculum Reform**	Academic Institutions, Teachers	Financial Constraints: Significant investment required for curriculum development. Resistance to Change: Traditional approaches may resist new curriculum integration.
2	**Faculty Development**	Academic Institutions, Teachers, Funding Bodies	Financial Constraints: Funding needed for workshops and training programs. Time Commitment: Faculty need substantial time for training and development.
3	**Industry Collaboration**	Industry Professionals, Professional Organizations, Academic Institutions	Resistance to Change: Industry professionals may need to adapt to new collaboration models. Time Commitment: Establishing and maintaining partnerships requires ongoing effort.
4	**Infrastructure and Resources**	Academic Institutions, Funding Bodies, Government Agencies	Financial Constraints: High costs for upgrading and expanding facilities. Lack of Infrastructure: Ensuring access to essential resources and equipment.
5	**Pedagogical Innovation**	Teachers, Academic Institutions, Professional Organizations, Students	Resistance to Change: Faculty and students may resist new teaching methods. Time Commitment: Implementing active learning methods requires additional preparation and adaptation.

- **Curriculum Reform:** Integrate sustainability principles into core courses like architectural design, planning, construction, and environmental design.
- **Faculty Development:** Provide workshops and training programs for faculty to equip them with the necessary skills and knowledge to effectively teach sustainable design principles, 21st-century skills, and relevant technologies.
- **Industry Collaboration:** Establish strong partnerships with professional organizations, architectural firms, and industry stakeholders to offer internships, guest lectures, and real-world design projects.
- **Infrastructure and Resources:** Invest in upgrading and expanding laboratory facilities, including the acquisition of new equipment like laser cutters, 3D printers, CNC machines, and advanced environmental testing equipment. Ensure access to high-quality and up-to-date software for design, simulation, analysis, and documentation, including BIM tools, urban design software, and environmental modelling software.
- **Pedagogical Innovation:** Employ active learning methods that promote critical thinking, problem-solving, collaboration, and communication. Incorporate project-based learning, studio-based design, and simulations to enhance practical skills and experiential learning. Utilize digital tools and software for design, analysis, and communication, exposing students to industry-standard software like BIM and GIS. Integrate real-world projects and case studies into the curriculum to connect theory with practice. Encourage community engagement through projects that address local societal needs and promote social responsibility.

5.1 Challenges of Implementation

Despite the robust framework, several obstacles must be acknowledged and mitigated for successful implementation as shown in ……challenges as the funding limitation, resistance toward change, and

curriculum integration must be overcome for applying the action plan. The details of the challenges are:

A. **Limited Funding:** Infrastructure Gaps: Many labs lack equipment, modern software, or sufficient computers. Sustainability Course Development: Requires trained faculty and access to specialized resources (climate data tools, simulation software).
B. **Resistance to Change:** Faculty Hesitancy: Some staff may resist interdisciplinary or student-centered teaching due to lack of exposure or training. Institutional Inertia: Existing rigid curricula and bureaucratic obstacles hinder flexible change.
C. **Curriculum Scalability and Integration:** Pilot programs may not scale across the full curriculum or be institutionally supported.

Table 5: Action Plan Challenges and Mitigation Strategies

CHALLENGE	IMPACT	MITIGATION STRATEGY
Limited Funding	Hinders lab upgrades, software acquisition, course development	External grants, industry sponsorships, EU-Egypt partnerships
Faculty Resistance	Delays adoption of new pedagogy and interdisciplinary models	Faculty training, incentives, collaborative course planning
Institutional Rigidity	Makes integration of new modules and methods slow	Embed changes in accreditation cycles and policy, use pilot phases
Curriculum Depth	One sustainability course is insufficient for deep learning	Introduce thematic studio integration, new elective modules, project-based learning
Assessment Gaps	Inconsistent evaluation of sustainability skills	Implement rubrics, simulation tests, reflective journals, and SDG-based evaluation

6. CONCLUSIONS

This research has identified some significant deficiencies in AU-Egypt's architectural education system that impede its ability to adequately prepare students for professional practice. The main issues include a mismatch between educational content and industry standards, inadequate training in sustainable design, outdated curricula, poor integration of social and environmental considerations, insufficiently equipped laboratories, and limited community involvement.

The proposed action plan aims to address these issues through comprehensive reforms in curriculum development, faculty training, industry partnerships, infrastructure improvements, and innovative teaching methods. By engaging various stakeholders—such as academic institutions, educators, industry professionals, government bodies, funding organizations, professional associations, and students, AU can revamp its architectural education framework.

The goal is to equip future architects with the necessary skills and knowledge for sustainable urban development, bridging the gap between academic learning and professional practice. Ongoing efforts will be crucial to maintain progress and adapt to the evolving needs of the industry.

By fostering "green competence" among graduates, this initiative seeks to significantly contribute to Egypt's sustainable development objectives, creating a built environment that is environmentally responsible, socially just, and economically sustainable.

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رعاية معمارِيّي المستقبل: إصلاحات مناهج تعليم العمارة لتحقيق الاستدامة والمهنية

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الملخص

يواجه تعليم العمارة تحديات متزايدة، خاصة في دمج مبادئ الاستدامة ومواءمة التعليم مع الممارسة المهنية. يقوم هذا البحث على دراسة الحالة الحالية لتعليم العمارة في مصر. من خلال منهجية متعددة الأساليب تشمل الاستبيانات والمقابلات ومراجعة الأدبيات، تحدد الدراسة التحديات والفجوات الرئيسية في المنهج الدراسي بقسم العمارة بكلية الفنون الجميلة بجامعة الإسكندرية. تبرز النتائج وجود فجوة كبيرة بين التدريب الأكاديمي ومتطلبات الصناعة، خاصة في التصميم المستدام والمهارات العملية. تقترح الدراسة خطة عمل لإصلاح المنهج الدراسي، مع التركيز على التعلم متعدد التخصصات، وتطوير أعضاء هيئة التدريس، والتعاون مع الصناعة.

تشمل خطة العمل المقترحة إصلاح المناهج الدراسية لتشمل مبادئ الاستدامة في الدورات الأساسية مثل التصميم المعماري والتخطيط والبناء والتصميم البيئي. كما تتضمن الخطة تطوير برامج تدريبية لأعضاء هيئة التدريس لتزويدهم بالمهارات والمعرفة اللازمة لتدريس مبادئ التصميم المستدام والمهارات الحديثة. بالإضافة إلى ذلك، تهدف الخطة إلى تعزيز التعاون مع الصناعة من خلال إنشاء شراكات قوية مع المنظمات المهنية والشركات المعمارية وأصحاب المصلحة في الصناعة لتقديم فرص تدريبية، ومحاضرات عامه، ومشروعات تصميم واقعية. كما تشمل الخطة تحسين البنية التحتية والموارد من خلال الاستثمار في تحديث وتوسيع مرافق المختبرات وضمان الوصول إلى برامج التصميم والمحاكاة الحديثة.

من خلال تنفيذ هذه التوصيات وتعزيز التعاون القوي بين الأوساط الأكاديمية والصناعة والوكالات الحكومية، يمكن لمصر تمكين جيل جديد من المهندسين المعماريين لقيادة الطريق نحو إنشاء بيئة مبنية مسؤولة بيئيًا وعادلة اجتماعيًا وقابلة للحياة اقتصاديًا. إن التنفيذ الناجح لخطة العمل المقترحة لن يفيد فقط الخريجين الذين يدخلون مهنة العمارة، بل سيساهم في نهاية المطاف في مستقبل أكثر استدامة ومرونة لمصر.

الكلمات الدالة: التعليم المعماري، الاستدامة، الكفاءة الخضراء، المناهج الدراسية، الممارسة المهنية، التعلم البيني

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