The MDX Living Pavilion: Making A Collaborative, Sustainable Learning and Wellbeing Space on Campus

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***Abstract*— The MDX Living Pavilion project at Middlesex University is a pioneering example of practice-based learning and interdisciplinary collaboration, aimed at fostering innovation in architectural education while addressing pressing environmental and societal challenges. Conceived in 2017 by academic staff, this flagship initiative enabled students to co-create a multifunctional pavilion, blending nature-inspired designs with sustainable and innovative materials. The pavilion serves as a learning, community, and wellbeing space for students, staff, and the local community, while acting as a legacy structure that future cohorts can adapt and evolve. The project's objectives align with Middlesex University's strategy, emphasizing real-world learning that connects with global goals: Quality Education (UNSDG 4), Industry, Innovation, and Infrastructure (UNSDG 9), and Sustainable Cities and Communities (UNSDG 11). Integrated within the Architectural Technology course, second- and third-year students undertook the challenge of designing and constructing a functional 60 m² pavilion. This involved theoretical application, technical skill development, and collaboration with stakeholders including the University Estates team, local authorities, industry professionals, and material specialists. This paper outlines the Pavilion Project's implementation across all stages and highlights its contributions to student learning, professional development, and sustainability. The project's achievements extend beyond the university, as it was a runner-up in the Guardian's University Award for Teaching Excellence and a finalist in the London Build Sustainable Construction Award, underscoring its educational and environmental significance.**

Keywords—Practice-Based Learning, interdisciplinary collaboration, real-life projects, sustainability and innovation

I. INTRODUCTION

The MDX Living Pavilion bridges theoretical learning with practical application, enabling architectural technology students at Middlesex University to engage in real-world projects. Tasked with designing and constructing a simple yet functional structure, second- and third-year cohorts collaborated with academics, university estates teams, industry experts, and material specialists to bring their vision to life. Students navigated complex project requirements, such as securing planning approvals, ensuring health and safety compliance, drafting business plans, and producing technical drawings, setting up the contract and monitoring progress on site during construction. They also sought sponsorships and negotiated discounts from suppliers.

The project was integrated into learning modules and assessments, emphasizing teamwork alongside individual accountability. Students were responsible for specific design elements, materials, and technical tasks, fostering skills in problem-solving, decision-making, and environmental impact reduction. These competencies not only enhanced their portfolios but also positioned them as highly employable professionals.

By engaging with this initiative, students experienced the full lifecycle of a construction project, from conception to completion. The MDX Living Pavilion thus exemplifies a real-case practice-based pedagogy, delivered through two academic modules over a two-year period. Weekly workshops and studio sessions facilitated by academics and industry professionals supported the students' progress, complemented by an online platform for sharing resources and documentation.

At its core, the pavilion embodies biophilic design principles, connecting occupants with nature and emphasizing sustainability, collaboration, and innovation. This initiative aligns with broader trends in architectural and engineering education that prioritize practical, interdisciplinary approaches to teaching.

The MDX Pavilion project's core aims and objectives aligns with Middlesex University's wider strategic goals, emphasising:

- A student-led, practice-based approach integrated within the university's broader strategy.
- A focus on enhancing the student experience and fostering interdisciplinary collaboration.

- Engaging with community and academic stakeholders to develop communication and consultation skills.
- Creating a flexible platform for learning and engagement for all departments.
- Promoting community-building through a shared, innovative space for learning and wellbeing.
- Aligning with sustainable and biophilic design principles to connect built spaces with nature.
- Offering opportunities for modification and adaptation by future cohorts of students.
- Encouraging active collaboration with over 17 companies blending academic and industry expertise.

The sections below presents the timeline and stages of the project and its outcomes.

II. PRACTICE-BASED LEARNING LITERATURE

In an era marked by rapidly shortening technological innovation cycles [1], higher education faces a growing imperative to prepare graduates with the critical cognitive and professional skills required to thrive in dynamic and fast-paced industries. Employers increasingly expect future-ready professionals to demonstrate advanced competencies in critical thinking, teamwork, problem-solving, and adaptability. In this context, practice-based learning (PBL) has emerged as a transformative pedagogical approach that bridges theoretical education and real-world application.

A. The Role of PBL in Fostering Professional Skills

PBL fosters an engaging and supportive learning environment by encouraging students to apply theoretical concepts to practical challenges. This active learning approach is particularly effective in developing transversal competencies, such as collaborative problem-solving, self-regulated learning, critical thinking, and effective communication [2], [3], [4], [5], [6], [7], [8] and [9]. For example, a framework was proposed by [9] to integrate Bloom's Taxonomy into STEM disciplines, which enables students to develop interdisciplinary knowledge and showcase creativity through competitive, hands-on projects like underwater robotics.

B. Sustainability Integration in PBL

As the demand for expertise in embodied carbon in building materials, renewable energy, energy efficiency, and sustainable urban development technologies grows, PBL is increasingly used to embed sustainability within educational curricula [10]. The approach [11] has been implemented through projects where students designed campus photovoltaic (PV) systems and related electrical devices. These initiatives required participants to anticipate the impacts of their designs on campus energy consumption and greening efforts, fostering both technical proficiency and environmental awareness. At an international level, collaborative platforms such as the Global Technology Initiative (GTI) Consortium [12] demonstrate how universities, industries, and government agencies can jointly tackle global challenges. By aligning project themes with the United Nations Sustainable Development Goals (UN SDGs), the GTI Consortium creates opportunities for student engagement in topics ranging from green energy to education, preparing them for careers in innovation-driven industries.

C. Frameworks and Methodologies Supporting PBL

Frameworks for practice-based education (PBE) [13], extend the principles of project-based learning by incorporating layered domains and capabilities drawn from industry co-design processes. These frameworks provide structural flexibility, allowing students to engage in workplace-like environments where they are mentored to tackle complex problems with environmental, socio-political, and technical dimensions. Through such initiatives, students gain hands-on experience as Vocational Placement Associates, actively contributing to industry and community projects aligned with the UN SDGs.

Universities are increasingly investing in PBL by building partnerships with industries and enhancing staff capacity to facilitate this mode of learning. This investment [14] ensures graduates possess robust skillsets tailored to the complexities of the modern workforce. Faculty development programs focus on training educators in cutting-edge industry practices and technologies, ensuring that instructional methodologies remain aligned with evolving professional demands.

D. Innovative PBL Applications in Architecture and Engineering

The potential of PBL in architecture and engineering disciplines is particularly noteworthy [15] and [16] The effectiveness of immersive boot camp formats for training professionals, emphasizing structured schedules, peer support, and social interaction [15]. In architectural design, community consultation meetings with local residents, planning officers, and industry experts offer students intensive, real-world learning opportunities that enrich their professional competence.

Vertical studio models [17] provide an additional layer of collaborative learning. By integrating bachelor- and master-level students in shared projects, vertical studios create a mentorship dynamic that encourages peer-supported learning. In architecture and architectural technology programs, such setups foster autonomous and reflective thinking, as students learn from the iterative processes and achievements of their peers. Exposure to interdisciplinary collaboration further motivates students to refine technical skills and explore innovative solutions in design.

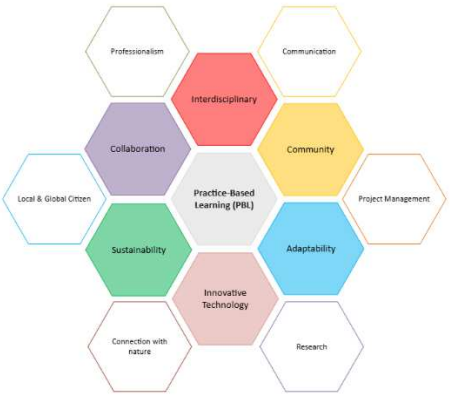

Fig 1. Practice-Based Learning Framework

Practice-based learning as depicted in Fig. 1 offers a holistic approach to education, blending theoretical knowledge with real-world application and fostering the skills needed for the workforce of the future. By integrating sustainability, collaboration, and innovation, PBL transforms learning spaces into dynamic hubs of creativity and problem-solving. As illustrated by diverse case studies across disciplines, PBL not only enhances academic performance but also equips students with the adaptability and technical

expertise to address the challenges of a rapidly changing global landscape. Institutions that prioritize PBL are better positioned to produce graduates who are both highly skilled professionals and agents of positive change in their fields.

III. CASE STUDY: PBL IN ARCHITECTURAL TECHNOLOGY

This section examines the MDX Living Pavilion project, highlighting its role in practice-based learning, architectural education, and sustainability. Situated on the Middlesex University campus, the MDX Pavilion is a multi-functional space designed for learning, events, community engagement, and well-being. Uniquely student-led, its design and construction involved second- and third-year Architectural Technology students working in collaboration with the Estates team, industry professionals, material specialists and contractors. This project exemplifies practice-based learning by immersing students in real-world challenges, from initial concept to final completion, while incorporating nature-inspired concepts, sustainable materials, and advanced technologies.

Through collaboration with architects in practice and consultant engineers and cost consultants students explored sustainable credentials, innovative material applications, and design principles aligned with Middlesex University's strategic goals. This flagship project underscores the achievements of academic-industry collaboration, enabling students to apply both technical expertise and transferable skills.

A. Project Story Timeline (as shown in Fig.2)

Fig2 illustrates some significant events throughout the time either in relation to the planning/ regulatory process or community events that had impact in the process of design, construction and beyond.

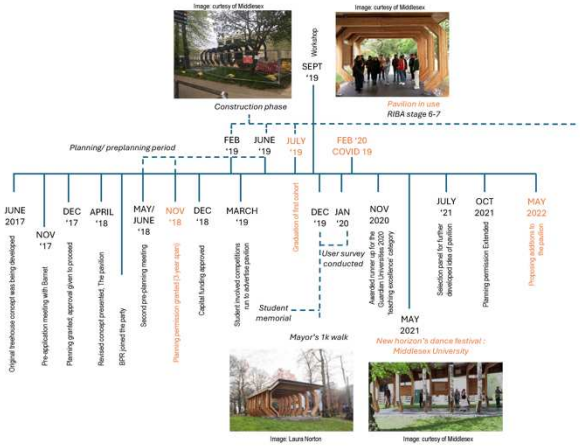

Fig 2. MDX Living Pavilion Timeline

Project Initiation: In spring 2017, a project brief was developed to engage students in creating a real-world structure utilizing academic resources. By September, the project was integrated into two programme modules. Students initially met with Barnet Planning Department, where a planning officer reviewed their designs. After site evaluations, a final location was selected based on recommendations.

Design and Planning: Students refined their designs and submitted a successful planning application in September 2018 in partnership with BPR Architects who were able to review and undersign the planning application on behalf of the students. The students developed the details and specification with the support of visiting architects and engineers from practice and a contract was agreed with the university's framework contractors in partnership with the university's estates team. The project then transitioned to construction phases (RIBA stages 5–6), culminating in June 2019.

Post-Occupancy Evaluation: A post-occupancy evaluation conducted in 2020 provided valuable insights into the Pavilion's use. Originally designed for routine university life, the Pavilion adapted unexpectedly during the COVID-19 pandemic, demonstrating its resilience and versatility.

B. Project Vision

The project was conceived with a clear educational vision that aligns closely with the strategic objectives of Middlesex University. The central motivations and educational goals of the project are as follows:

- **Creating a vibrant, practice-based student learning experience** that fosters collaboration and real-world application where Students are actively involving and contributing to sustainable campus development.
- **Showcasing innovation and sustainability** to both the university community and the wider Hendon and Barnet areas.
- **Positioning Middlesex University** as a leader in innovative and forward-thinking education, emphasizing the unique aspects of learning at MDX.

The philosophy underlying the project was to develop an evolving structure that could be modified and adapted by future cohorts of students. This dynamic approach allowed for the extension of practice-based learning across multiple disciplines throughout the project's lifecycle. Students were not only involved in the design and construction phases but also had the opportunity to observe and contribute to the building's ongoing use and adaptation. The project exemplified the value of collaboration, offering opportunities for research and development partnerships with innovative bio-material companies such as BIOHM. These partnerships further enriched the students' learning experience, incorporating cutting-edge sustainable technologies. The completed building will serve as a multi-functional space, providing a platform for learning, exhibitions, well-being, reflection, and community engagement.

C. Project Assessment Strategy

The assessment strategy for the project was comprehensive and multifaceted, designed to evaluate a wide range of student skills and competencies across both modules. Assessment methods included self-assessment, peer reviews, in-depth reports, presentations, both physical and digital modeling, drawings and documentation facilitated by Building Information Modeling (BIM) tools and processes. These diverse assessment modes aimed to measure students' technical expertise as well as their abilities in teamwork, communication, information management and presentation.

The project reports, which formed a significant part of the assessment, included critical statutory documents such as the Design and Access Statement—a requirement for planning applications submitted to local authorities—and the User Guide, which serves as a practical resource for the building's operational phase. This thorough approach ensured that students were assessed not only on their technical proficiency

but also on their ability to engage with real-world documentation, regulatory processes, and collaborative practices.

D. Interdisciplinary and Practice-Based Approach

The Pavilion project bridges theoretical knowledge with real-world application. Interdisciplinary collaboration was key, engaging students across disciplines such as Graphic Design, Photography, Dance, Product Design and Engineering. This approach enriched the Architectural Technology curriculum while fostering a deeper understanding of sustainability and design.

E. Design Process

1) Concept Design:

The design process began with students navigating the complex planning approval procedure, providing them with invaluable insights into regulatory compliance and project management. During the conceptual phase, students collaborated closely with the University's Estates team and external consultants to develop the project's business case and secure funding. Through successful negotiations with suppliers and sponsors, the students were able to reduce project costs, thereby demonstrating their practical understanding of financial management in real-world construction contexts. The Pavilion's location was strategically chosen for its accessibility, positioned at a key interchange between public and student routes on the Hendon campus. Key design drivers included minimizing the environmental impact of the structure while creating a visually striking and flexible space that could be utilized by both students and local community members.

2) Developing the Business Case:

In parallel with the design development, students worked to create a comprehensive business case, which was subsequently presented to the University's Infrastructure Investment Appraisal Board (IIAB) Fig. 3. The approval to proceed with the planning process marked a pivotal moment in the project and provided students with a valuable educational experience in understanding the financial considerations involved in project acquisition. This phase helped students grasp the complexities of balancing financial constraints with design aspirations, enriching their understanding of the construction industry's financial dynamics.

Fig 3. Business Case Student Presentation to IIAB Board Meeting

3) Material Exploration and Innovation:

Throughout the design process, students were encouraged to explore innovative materials and sustainable design practices. Visits to locations such as the Design Centre informed their material choices. In the first year, students selected Mycelium panels provided by Biohm, a company specializing in bio-based materials. These panels are formed by allowing fungi to consume organic and synthetic waste, producing shapes that are both aesthetically appealing and thermally insulating.

Fig 4. Sedum Blanket Green Roof

A green roof system (Fig. 4), donated by Bauder, was incorporated to showcase the Pavilion's sustainable vision, providing a living example of environmental responsibility. Additionally, Eco-dek flooring, made from recycled plastic, was selected to test the viability of using sustainable materials in construction while maintaining an aesthetically pleasing finish in a high-profile space. The glulam timber frame was another key material choice, selected for its carbon-positive properties. Supported by steel screw piles, the frame eliminated the need for concrete foundations, thereby minimizing the environmental impact on the adjacent trees and landscape. This decision aligned with the project's core sustainability objectives and anticipated future iterations of the design that would incorporate emerging technologies.

4) Sustainability at the Core:

Sustainability was the primary guiding principle throughout the design and material selection processes. Following a visit to Eco-Build, students were inspired to explore the use of alternative, less conventional materials in the Pavilion's construction. A notable example was the incorporation of ORB panels—made from organic waste materials—alongside the Mycelium panels, both of which were sponsored by Biohm. These innovative materials were used to enhance the building's marine plywood soffit and contributed to the Pavilion's zero-carbon vision. Biohm's approach promotes a circular economy by reusing waste materials, thereby reducing resource consumption and minimizing environmental impact. Mycelium, as a material, offers the unique ability to consume both organic and synthetic waste, growing into custom shapes whose properties can vary depending on the types of waste used in the process. ORB, made by binding food and agricultural waste, can be moulded into intricate three-dimensional forms without the use of synthetic additives. Both materials are 100% natural, biodegradable, and even edible, offering a sustainable alternative to traditional building materials. These materials were used not only to embody the Pavilion's sustainable ethos but also to actively demonstrate innovation in bio-based material usage within the built environment. The Pavilion's ceiling design further exemplifies the project's commitment to sustainability. Mycelium and ORB panels (Fig. 5), used in the ceiling design, were cultivated from food and agricultural

waste sourced from local businesses such as Google HQ, Heathrow Airport, and Extract Coffee. This approach underscored the Pavilion's dedication to reducing its carbon footprint while showcasing innovation in bio-based construction.

Fig 5. Mycelium and ORB Ceiling Panels

5) Long term phased Practice-Based Learning Strategy: The incorporation of new materials and testing methods lies at the heart of the MDX Pavilion's design evolution. The development of a physical structure as part of the curriculum, which is then adapted over time by future cohorts, offers a novel approach to teaching Architectural Technology at Middlesex University. The intention is to enable the project to support future cohorts. The first phase of development provided a foundation, frame and roof of a pavilion that can be used across departments. This basic frame provides a structure that the next cohort of students can examine and adapt for future needs by enclosing on the walls with doors and windows for example. Future years can then consider carrying out alterations to the existing structure to respond to changing pedagogies or specific departmental requirements. In this way the project can continue to be a living pavilion, responding to changing needs whilst supporting future generations of students. The Pavilion's design therefore creates a lasting educational resource, enabling future students to learn from past design iterations and gain a wealth of practical experience. Through this iterative learning process, the project serves as both a teaching tool and a living example of sustainable design, where each generation of students contributes to its growth and adaptation in response to emerging technological and environmental challenges.

F. Construction Process

The construction process involved extensive collaboration between the students, the University's Estates team, framework professional consultants, regulatory bodies, framework contractors and site management teams. Central to this phase was the integration of sustainable building practices, which guided every aspect of the project's realization. Throughout the construction phase, students played an active role in various tasks, ranging from carrying out site visits to monitor site progress to managing site logistics and ensuring compliance with health and safety regulations. They also contributed to the design and implementation of sustainable building solutions, gaining hands-on experience in a real-world setting.

Students made regular visits to the construction site, where they engaged in question-and-answer sessions with the site manager. These interactions provided valuable insights into the practical implications of their design decisions and deepened their understanding of how theoretical knowledge applies to actual building processes. In addition, as part of their coursework, students were required to produce weekly site visit reports, documenting any challenges or issues encountered during construction. This task reinforced their ability to analyse and address real-world problems, further enhancing their professional development and contributing to the campus's commitment to sustainable development and community engagement.

The contract was agreed between the Universities Estates Team and Surecast Construction Ltd under the terms of the university's framework agreement. The contract was administered by BPR Architects Ltd who followed formal procedures under the contract through the issue of Instructions, certificates and Site Meeting minutes. The students were kept informed of all formal communication between the client, contract administrator and contractor and were able to challenge, ask questions and engage in discussions about any issues that arose. The students attended site meetings and were issued with copies of the site meeting minutes giving them a real-world insight into the types of communications and conversations that take place when managing a construction contract.

As the project emerged from the ground, the students witnessed their design come to fruition giving them a sense of achievement and the experience of how they might influence construction projects in the future. They learnt the importance of accurate drawings and clear communication, and the need to provide information on time so that the contractor could meet construction programme deadlines. All the external construction professionals who gave their support to this unique project went out of their way to help the students, taking time to explain complex contractual procedures and showing the students how construction sites are managed.

G. Innovative Use of Sustainable Materials

Sustainability was a core principle embedded within the brief for the MDX Pavilion, guiding every phase of its design and construction. From the outset, the project was conceived with the goal of minimizing its environmental impact. As a primary structural material, timber was selected for its renewable properties and low environmental footprint. Initially, Cross Laminated Timber (CLT) was considered; however, as the design progressed, Glue Laminated Timber (glulam) was ultimately chosen for the pavilion's structural octagonal frame. This material was preferred due to its superior strength-to-weight ratio, ease of fabrication, and overall sustainability. The glulam frame is supported by screw pile foundations, a method that further minimizes the impact on the adjacent landscape by avoiding traditional concrete foundations. Surrounding the base of the structure, gabion baskets serve as a retaining wall, adding to the aesthetic and functional value of the design. The pavilion's roofing system consists of a mono-pitched timber roof, which supports a green roof system donated by Bauder. The green roof, composed of a single-layer, lightweight Sedum system, incorporates more than 80% recycled materials, enhancing the building's ecological credentials. This integration of a green roof not only contributes to rainwater harvesting,

reducing the impact on the local drainage system but also supports biodiversity and reduces the building's overall carbon footprint.

The glulam structure was delivered in three prefabricated pieces, which were assembled on-site into their hexagonal shape by the manufacturer. The natural finish of the glulam will weather over time, adding to the pavilion's organic aesthetic and ensuring that its appearance evolves as part of its lifecycle. For the flooring, Eco-deck floorboards were chosen, which are composed of a blend of recycled wood and recycled plastic to form a wood-polymer composite. These boards provide a durable, low-maintenance base for the pavilion and align with the project's sustainability goals.

Further enhancing the building's commitment to sustainability, mycelium decorative wall panels were incorporated into the design. Produced by Biohm, these panels are an example of biomimicry technology and showcase the potential of fungi-based materials in construction. Throughout the design process, careful consideration was given to minimizing waste, reducing energy consumption, and improving resource efficiency. Elements of the pavilion were designed for off-site construction, reducing material waste and improving the efficiency of the assembly process. The timber frame was prefabricated and delivered in modular pieces, further contributing to sustainability. In terms of energy use, the pavilion was designed to be open and unheated, maximizing natural daylight and reducing reliance on artificial lighting. To ensure energy efficiency, LED lighting was installed, activated only when the pavilion is in use during the evening hours. Additionally, the pavilion's location near existing toilet facilities on campus eliminates the need for water infrastructure, further reducing the environmental impact of the building.

Fig 6. Glu-laminated Frames

Incorporating environmentally friendly materials such as a glu-lam timber structure (Fig. 6) not only enhances the sustainability of the pavilion but also positions the project as a model for eco-friendly construction practices. These materials demonstrate the potential of innovative, circular economy approaches in building design and reflect the growing importance of sustainability in contemporary architecture. The use of such materials also highlights the significance of research and development in the exploration of alternative, low impact building technologies, marking the MDX Pavilion as a forward-thinking project in both design and construction.

H. Funding, Planning and Stakeholder Engagement

The MDX Living Pavilion project involved extensive engagement with local authorities, industry professionals, and various stakeholders, all of whom played a crucial role in shaping the success of the initiative. The development of a comprehensive business case was central to securing project approval, detailing the long-term educational and environmental benefits of the pavilion. This business case outlined the project's objectives, sustainability goals, and anticipated impact on the university community, providing a solid foundation for discussions with stakeholders and ensuring alignment with institutional priorities.

The funding acquisition process was another key element of the project's success. This process involved strategic negotiations with sponsors, suppliers, and partners, which helped secure both financial and material contributions. Collaborative discussions with these stakeholders were critical in managing project costs and ensuring the pavilion's materials and design adhered to sustainability standards. The ability to negotiate effectively with these partners not only helped maintain the financial viability of the project but also fostered strong relationships that continue to benefit both the university and the broader construction industry.

Beyond its immediate educational value, the MDX Living Pavilion has had a significant impact on the university community and beyond. Since its completion, the pavilion has become a dynamic space for a wide range of events, including workshops, fitness classes, religious festivals, and dance performances. Its adaptable design encourages diverse uses, promoting greater interaction with the environment and fostering sustainable practices. As a result, the pavilion has become a symbol of innovation and versatility, supporting both academic and community engagement.

The project has also made a substantial contribution to the professional development of students. By providing hands-on experience in real-world construction, project management, and design, the pavilion has significantly enhanced students' portfolios and employability. Many students have cited their involvement in the project as pivotal in shaping their career aspirations, with some opting to pursue further studies in construction management and related fields. Feedback from industry partners has been overwhelmingly positive, with construction professionals expressing pride in mentoring the next generation of architectural technologists.

The MDX Living Pavilion continues to serve as a hub for interdisciplinary collaboration at Middlesex University. Students from a wide array of disciplines, including Photography, TV Production, Graphic Design, Interior Architecture, Design Engineering, and Dance, have utilized the space for various projects. These include promotional videos, marketing materials, and the integration of sensor-based technologies to enhance user interaction with the space. Architectural Technology students have also conducted post-occupancy workshop to assess the pavilion's usage and inform future design iterations. It stands as a testament to the value of experiential learning, sustainable design, and interdisciplinary collaboration. It not only provides a functional and versatile space for the university community but also serves as an ongoing educational resource. By enabling future students to build upon and adapt the structure, the pavilion ensures that

the lessons learned from its design and construction will continue to shape the development of architecture and environmental design in the years to come.

IV. RESULTS AND DISCUSSIONS

A. Impact on Students Development and Employability

The MDX Living Pavilion project has significantly contributed to the professional development of students, enhancing their portfolios and providing unique hands-on experience in construction and project management. The students gained practical insights into problem-solving and decision-making, learning how their design choices impact the environment and how to mitigate these effects. One graduate, for instance, confirmed that the project motivated her decision to pursue a master's degree in project management with a focus on construction. She stated, *"I experienced what it is to manage a real-life project."* Another student reflected on the lessons learned, saying, "*I learned a lot about teamwork and planning, how to make changes to reduce costs, and gained valuable insight into the industry.*"

Fig 7. Students Site Visit with Site Manager

The project played a crucial role in enhancing students' practical skills, portfolios, and employability, with some students experiencing a shift in their career trajectories because of their involvement. The project provided a collaborative and supportive environment, allowing students to work closely with professionals (Fig. 7) and gain insights that would otherwise not be available. As one of the project's framework contractors explained: "*During the build, we were further engaged with the students attending the site each week to review progress at all stages. Our Site Manager appreciated the inquisitive nature of the students and felt a sense of pride in sharing his practical knowledge with the next generation of construction professionals."*

The students' engagement with statutory documents, such as the Design and Access Statement and the User Guide—both integral parts of the assessment process—also fostered a deeper understanding of the regulatory and operational aspects of construction. These assessments provided students with the opportunity to explore the complexities of legal compliance, and the documentation required for both the planning and operational phases of the project.

B. Community and campus engagement

Since its completion in June 2019, the MDX Pavilion has served as a versatile venue for a wide range of events, benefiting both the university community and the local population. Over 18 distinct events have taken place, ranging from staff workshops and fitness classes to cultural festivals and art installations. Notable events include the University's Jewish Society's Feast of Tabernacles Festival, yoga and fitness classes, and outdoor art performances, showcasing the Pavilion's capacity to foster community engagement and promote sustainability. The Pavilion's flexibility as an event space has played a key role in supporting both university and community activities, offering a platform for cultural, academic, and social exchanges. As a result, the Pavilion has become an essential part of the campus (Fig. 8), fostering a sense of connection and well-being among students, staff, and the surrounding community.

Fig 8. Pavilion in use for an Induction Session

C. Interdisciplinary Collaboration and Ongoing Uses

The Pavilion has continued to serve as an interactive and multifunctional space that promotes learning, exhibition, well-being, reflection, and community interaction. Examples of its ongoing uses include:

- **Educational Space**: The Pavilion provides a unique learning environment where students engage with nature and discuss sustainability, renewable energy, and innovative materials.
- **Event Space**: It has hosted welcome events, speed networking sessions, creative society activities, outdoor cinema screenings, exhibitions, and performance art events.
- **Well-being Space**: The Pavilion has been used for yoga and tai chi classes during the summer months, offering a space for relaxation and personal reflection.
- **Community Outreach**: Local schools have utilized the Pavilion for STEM activities, where students discuss sustainability and the Pavilion's role in environmental education.
- **Future Learning Opportunities**: The Pavilion also provides opportunities for future students to assess the completed project, reflecting on its successes and challenges, which will inform the ongoing evolution of the site and building.

The Pavilion's outdoor yet sheltered design has proven invaluable, especially during the COVID-19 pandemic. With its well-ventilated environment, the Pavilion became a safe space for students, including Stop Motion Animation students, who used the space to create films during lockdowns.

Furthermore, the Pavilion has remained an integral part of the curriculum for various courses (Fig. 9). For example, BA Photography students documented the construction process, TV Production students created a promotional video, Graphic Design students developed marketing materials, and Design Engineering students contributed sensor technologies to enhance the Pavilion's functionality. Product Design students also designed signage for the space, while Dance students have used the Pavilion for performances.

Fig 9. Community Workshop

D. Recognition and awards

Fig 10. Pavilion Accolades

The MDX Living Pavilion has received significant recognition (Fig. 10) for its contributions to higher education and sustainability. It was named a runner-up for The Guardian University Award for Teaching Excellence and was a finalist for the London Build Sustainable Construction Award. These accolades highlight the Pavilion's success in both educational innovation and sustainable construction practices. The Pavilion continues to inspire future generations of students, offering an adaptable and evolving platform for experiential learning, cross-disciplinary collaboration, and environmental stewardship.

TABLE I. POST OCCUPANCY INSIGHTS

Activities in the Pavilion	- Teacher training for Early Years, Primary, and Secondary studies - Outdoor induction sessions - Poetry sharing sessions - Storytelling - Meditation
Educational Benefits	- Encourages learning outside the classroom - Usable in rainy weather - Few outdoor spaces for activities on campus - Potential for drama/performance stage (no extra fittings needed) - Panels can sometimes be distracting
Quality of Open Space	- Sparks curiosity about design and learning - Avoids becoming another standard classroom - Heating not needed; students bring suitable clothing - Proximity creates warmth for comfort
Additional Comments	- Moves away from 19th-century classroom model - Innovative temporary enclosures could enhance the space - Create a video to demonstrate Pavilion use - Bring local schoolchildren for learning activities with GPS apps

The project has significantly contributed to the development of future architectural solutions through a post-occupancy workshop (Table I) conducted by students to evaluate user interaction and usage of the Pavilion. These evaluations provided valuable insights that informed the creation of a brief for a flexible enclosure to be implemented in future years. New design proposals, developed from these insights, were presented to consultants and university specialists, with the two best schemes showcased at the 'Posters in Parliament' annual event in 2020, 2022, and 2023.

V. LESSONS LEARNT, LEGACY AND FUTURE WORK

This model of real-case PBL can be replicated or adapted in other institutional contexts, so long as it is integrated within the curriculum and assessment. Demonstrating the project's educational and environmental outcomes, this section outlines our reflections on learning outcomes for students as result of involvement in Pavilion project which underscores the value of experiential learning, sustainable design, and interdisciplinary collaboration. It also summarises the challenges faced during the project's development, its alignment with curriculum and assessment along with the strategies employed to address them. They include:

A. Planning and Time Management

In meeting the demands of the project timelines, the students learnt to appreciate the need to plan their work and prepare information on time. The project had secured funding from the estates department over two years. It was agreed that if students were to gain from the experience of seeing the project being built on site, then planning would need to be obtained in year one and construction would be expected to start in year two. It was therefore necessary to identify the site, agree the design strategy and prepare design proposals for planning approval in year one and identify suitable materials, prepare details and issue contract documents to the contractor in year two.

B. Collaboration and Communication with Construction Professionals

Students worked with the academic tutors, design team and construction professionals that were required to support the project. Students prepared design drawings, and the architect and structural engineer were required to adapt to the academic vision for the project and students' expectations and accommodate their needs in their technical and contract documentation. For example, the students desire to reduce the carbon embodied in the concrete of the foundations, as recommended in the brief and suggested by the structural engineer, necessitated the need for the foundations to be re-designed to make use of lightweight screw piles instead – which carry much less embodied carbon.

C. Obtaining Approvals and responding to Statutory Requirements

It was necessary to obtain planning permission from the local authority both to ensure compliance with the local plan and build a commitment from the council to encourage them to engage and make use of the project. This process demonstrated to the students the complex negotiations that are required to obtain approval for buildings in the UK. For example, a preferred location was identified on the campus in an area of land known as 'The Paddock'. The site would be visible from the local streets to both encourage participation with the local community and promote the positive activities that the University is doing with their students. However, the local authority found this location to be too obtrusive and they feared that development on the paddock would be harmful to

the amenity of the local area. It was therefore necessary to meet with the local authority and identify a less obtrusive site location that meets both the needs of the project and the local authority planners, showing the students how important it is to engage and work together with local council stakeholders.

D. Coordination with university as a stakeholder

The project offered opportunities for Project Based Learning to several different faculties across the university. To ensure that the proposed design would meet the needs of the other university courses, the students learnt that it would be necessary to consult with the faculty stakeholders to determine their requirements. For example, Fine Art anticipated the need to suspend sculptural exhibits from the structural frame. A support mechanism was therefore introduced, and structural loading requirements determined in order that the structural engineer could ensure that the frame was strong enough to support future 3-dimensional art installations. The electrical loading and lighting requirements were determined by the estates department and the students had to learn to co-ordinate the design of the cable routes and access points to minimise disruption to their design vision.

E. Sustainable design through specification of low carbon materials

Every effort was made to minimise the environmental impact of the proposed Pavilion. The students soon found that the choice of materials to be used for the structure and finishes would have a significant impact on embodied carbon emissions. As well as avoiding the use of concrete foundations and using a timber structural frame, the students selected a recycled plastic decking system and specified a living roof.

F. Importance of accurate drawings and specifications

As the drawings developed from sketch proposals through outline design stage and into detailed drawings supported by a specification, it became apparent to the students that they had to accommodate live project requirements that did not always align with their initial vision. For example, the Biohm Mycelium based cladding panels selected by the students as a carbon positive cladding system, could not be supplied in the small quantities needed for this project. Biohm therefore agreed to provide some sample decorative panels that could be used for display instead. Alternative cladding panels were identified and the Biohm panels were applied over, with the detailed design drawings adjusted accordingly.

G. Formal communication procedures required in live contracts

Offering the students the opportunity to witness the construction on site of a project that they have been directly involved in, provides an exceptional experience that adds great value to their employability. Witnessing that the drawings provided to the contractor for construction needed to be checked for accuracy by setting out the dimensions across the site, showed that adjustments were needed to allow for a clash with a tree canopy over and potential below ground obstructions. The importance of formal communication that the contractor could rely on became clear as they ordered materials and equipment. Students witnessed how formal certificates and instructions were backed up by structured site meetings attended by the students, the design team and the contractor, enabling the contractor to make sure that they clearly understood the instructions provided.

H. Responding to site conditions

As the foundations were dug and the frame installed, the students could begin to witness the excitement of seeing their ideas come to life. However, there were inevitably more issues to consider as they started work, including how the contractor would gain access to the site, which was now located further away from the main road and along a pedestrian footpath. The contractor prepared a construction methodology that showed the contractors compound and out of hours delivery of materials that would keep the public footpath open during the day. The students discovered that the responsibility for designing the construction methodology was with the contractor, but that the design prepared by the architect would have a significant impact on the pavilion's buildability.

I. Employability and professional development

The MDX Pavilion project significantly contributed to the students' employability, offering them practical experience in project management, design, and construction processes. Many students noted that their involvement in the project gave them a competitive edge in job interviews, with several citing the opportunity to work on a real-world project as a transformative experience. Students emphasized how the collaborative nature of the project helped them develop critical soft skills, such as teamwork, problem-solving, and communication, which are essential for success in professional environments.

J. Feedback and Course Evaluation

Student feedback on the course was overwhelmingly positive, particularly regarding the opportunity to work on a live project. Many students highlighted the transformative nature of the Pavilion project, emphasizing how it allowed them to apply theoretical knowledge in a real-world context. One student remarked, "*Real-life projects, particularly the Pavilion, gave me a once-in-a-lifetime experience*." Another noted, "*The opportunity to experience working on the Pavilion each term was transformative and a real boost to my confidence.*" These insights reflect the effectiveness of experiential learning in enhancing students' problem-solving abilities, collaboration, and adaptability [16].

K. The University's Estate Team Perspective

From the perspective of the university's Estates team, the MDX Pavilion project has fostered closer collaboration between the academic community and the Estates department. This partnership has created opportunities for students to engage with industry professionals and participate in decision-making processes, strengthening their understanding of real-world construction practices. Furthermore, the involvement of students in the project has enhanced the university's commitment to supporting the next generation of construction professionals and contributing to the adoption of innovative products and practices in the built environment.

L. Looking Ahead: Future Developments

The successful collaboration between academia, industry, and local authorities has established a framework for future developments of the Pavilion (Fig. 11). The project has opened avenues for ongoing design iterations and has set the stage for further interdisciplinary collaboration. Future phases of the project will continue to provide valuable learning opportunities for students, allowing them to build on the lessons learned and refine their skills. The Pavilion's evolution

fosters continued collaboration between students, faculty, and industry professionals, further advancing the goals of sustainability, innovation, and community engagement.

Fig 11. Pavilion Space

VI. CONCLUSIONS

In conclusion, the MDX Pavilion has left a significant legacy in terms of educational impact, community involvement, and sustainable design. It has provided students with hands-on experience in construction, project management, and sustainability, while also fostering interdisciplinary collaboration. As the project continues to evolve, it will further contribute to the growth and success of both the university and the broader community. A framework for the projects development over the coming years has been established through the collaboration of academia, industry and the local authority. New relationships have been established between the various parties involved including Students, University Estates and Executives, Consultants, Contractors and Local Planning Department. The project promoted personal development for all members of the team and brought together a wide range of skills and experiences to deliver the statement structure.

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Fig 12. Image of some students and consultants logos

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