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His work spans design for complex products including DFMA, and systems thinking where he deploys Computer Based Design Models as a medium for information and knowledge capture and sharing to facilitate and enhance learning. He continuously supports students by bringing in a wealth of experience and practical knowledge from practice especially where accessibility, information management and human centred collaboration are required foraddressingindustry-orientedchallenges and innovation.

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The Role of Computer-Based Knowledge Acquisition in Industry-Oriented Collaboration for Responsible Design

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Abstract

Designing in response to industry-led briefs is a knowledge-intensive learning process that requires students to engage with complex real-world challenges. Brunel Design School frequently collaborates with organisations, businesses, and SMEs worldwide to develop creative briefs that form an integral part of students' learning experiences. The value of this approach lies not only in the generation of innovative design concepts but also in students' ability to accurately interpret industrial requirements and translate them into solutions that effectively address user needs.

This paper examines the implications of a spatial design brief developed through collaboration between three organisations, a globally recognised audio equipment brand, a UK-based high-street retailer and a design agency with the university. The objective was to design an accurate representation of a non-assisted retail sales experience within a 3m × 3m installation footprint.

The brief included more than 200 pages of technical, and visual requirements, supported by over 12x three-dimensional computer-based models to assist students in developing their design solutions.

The project was undertaken by 58 second-year students for their Design Practice module, who are generally enrolled in Industrial Design BA, Design BSc, and Product Design Engineering BSc programmes. Findings demonstrate the effectiveness of 3D computer models in supporting design knowledge acquisition throughout the project, which involved four industry collaboration workshops, ten seminar sessions, and the production of final artefacts through 3D printing, presentation and fabrication-based work over an eight-week period with guidance given around navigating the world of generative AI without compromising critical knowledge building.

The results highlight the importance of computer-based models in industry-led collaborative projects, enabling students to develop authentic, high-quality, and award-winning design solutions through real world design reference points. Furthermore, the study demonstrates how such collaborations can strengthen industry-academia engagement while inspiring and preparing future generations of designers to be more responsible.

Keywords

Knowledge-based Design, Computer Aided Design, Systems Thinking, Experiential Learning

Introduction: The role of collaborative design for multi-disciplinary skill attainment and professional practice

It is well known that academia and industry need to foster and grow collaborative project-based learning together to create a future

prosperous education sector as well as prepare the workforce to transition into real-life experience.

UNESCO now calls for provisions in education that are more holistic, that can envision change and foster transformation through multi-disciplinary collaborations which can be formed outside of formal governance structures as mentioned by Pritchard et al.(2023). More involvement of external organisations is needed to achieve these outcomes, engage the students, staff and communities and better embrace responsible change. This approach, supported by experiential learning pedagogy offers a transformative model of practice, that is able to indicate what real-world learning could do to develop the students' understanding and provide education for a more responsible future.

At Brunel Design School, students on a second year core module were directed to directly get involved with three major UK based companies to address a retail design challenge as part of their module. Its purpose was to fulfil not only the strategic goals of the organisations involved and the university, but also to focus on the experiences shared in the activities involved that develop and grow the skillset of the students and enhance their preparations to face the external world. The school believes that these opportunities can allow them to build up their real life design content for their portfolios going forward.

Underlying this mechanism is the Kolb's cycle where experience, reflection, conceptualisation and experimentation take place within the overall delivery of experiential learning education.

In medical disciplines (Biotech)for example, ELC (experiential learning cycle theory) had been used to cultivate new talent by

facilitating high quality experiences and enable systemic innovation (Zong et al, 2026).Within this context, responsible design education extends beyond the production of functional artefacts and encourages future designers to consider the broader consequences of their decisions.

The challenge briefed the students within the Retail environment not only focuses on the technical innovation behind managing a 3m x 3m spatial design project, but also by considering diverse communities with different abilities, cultural backgrounds and expectations to reflect the wider profiles of shoppers. Preparing students to interpret industry requirements through human-centred, ethical and inclusive perspectives becomes an important aspect of contemporary design practice that delves beyond pure technical requirements. Our approach particularly explores how industry collaboration and computer-based design knowledge acquisition can support students in developing more responsible approaches to designing physical and experiential environments for diversifying scenarios of use and assuming a wider range of abilities from the target audience that defaults to our minds.

In effect, both Kolb's (Kolb, 1984) and the role of computer-based knowledge acquisition (Kugler et al. 2023), enable students to further reach into responsible design arenas, by providing (as educational environments) access to authentic industry data models, and assets, as well as multidisciplinary teaching, mentoring and continuous industry feedback cycles that are more aligned with a truly reflective cycle of the product's development lifecycle. The student's embodiment of their experiences through the design of their final physical and digital prototypes have resulted in professional-quality outcomes and recognition.

Industry-Academia Transformational Processes

The collaborating companies were asked to discuss their early thoughts of the design challenge they want to set. Our team then translated it into first, a formal academic pro forma document that contain the challenge in bite-sized structure, simple enough to be read from a single A4sheet but implicitly containing a potential raft of multi-disciplinary areas and specialisations that the students could get inspired, and encouraged to further develop their interests into subsequent disciplines as seen in figure 1 below.

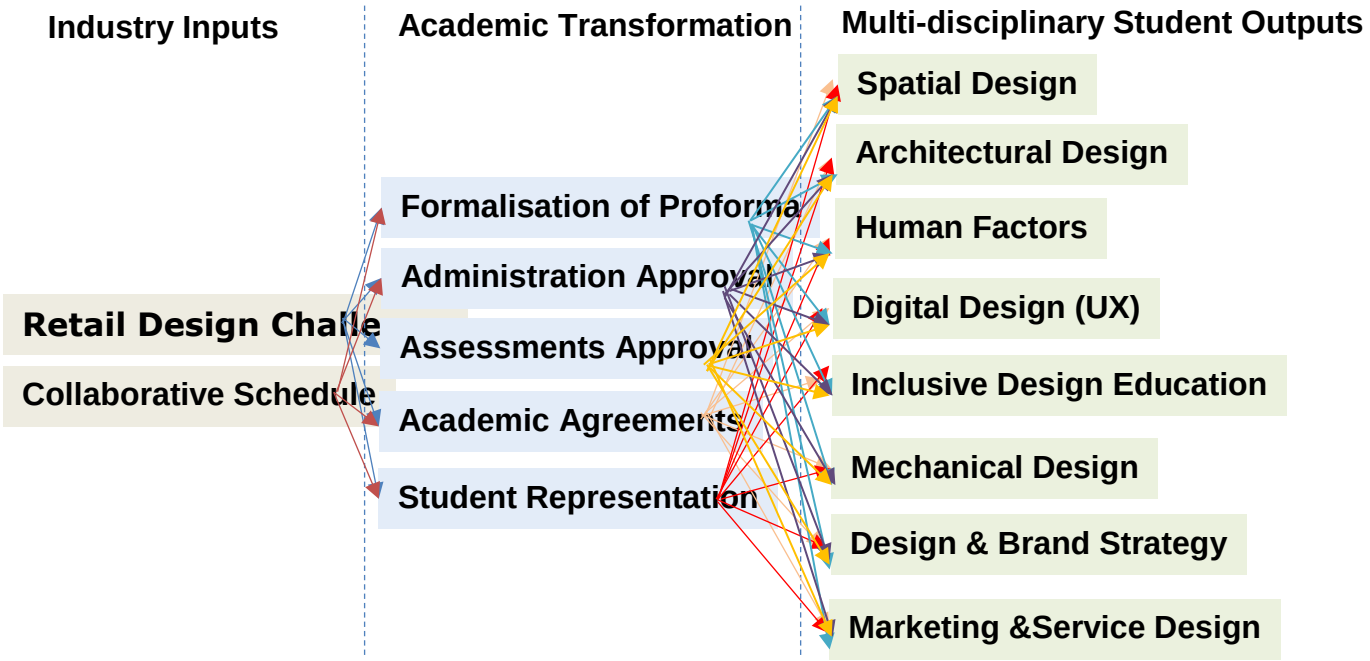


Figure 1 Above. Transformation of Industry inputs through academic collaboration to multi-disciplinary areas for students to develop their skill set.

On the left of the diagram, a timeline with our collaborators (collaborative schedule) is input into our discussions, alongside the challenge. Following on from that, the formalisation of the proforma,

along with approvals from admin, assessment units, and academics and students involved was sought. Carefully designed, eight disciplinary opportunities, defined by certain keywords to enable students to further enquire.

Design, being a universal language is not afraid to deal with new areas of knowledge acquisition (Almeqdad et al, 2023) especially when dealing with diverse learning styles. Having started off with a brief to design a retail space for a audio equipment company to promote their products, the brief itself had undergone a transformative process of elaborating on each keyword within the brief into a whole potential for students to delve into during their experience by creating critiques within these topics within their weekly seminars and workshop sessions.

The common requirement of designing a 3 meter by 3 meter enclosure now translates into a series of enquiry based structures for students to follow through. These structures are used as scaffolds in the practice based learning environment evolving around the classroom seminars and discursive workshop sessions. They can be shown, evolved and further elaborated by following through the questioning prompts used below as conversation starters, and let critical thinking do the rest:

What does it take to fill a space of key brand messaging points?, How can an interesting, exciting and 'loud' space for the brand be created? How the pathways for customers to walk within that space -be created safely, yet capture their attention and enhance their senses?. This kind of questioning allowed students not only to think about the space and furniture, and hardware fixings within it, but also to convey

aesthetic value and visual presence. Using certain examples of brand messeging from around the world also reinfornced these enquiries.

The words‘ safety, attention, senses’ – provided a gate away to explore how design can be used in translating those singular key words into a more richer, wider context delivered through discursive and practice based ideation sessions. Not only allowing students to place careful attention on how the space is used, but how will it also be prevented from misuse, by placing strong emphasis on safe spaces, and injury prevention measures in the way things are placed within the environment.

Other prompts used – How can designing table tops, stands, décor, can be achieved in accordance to the human body size typical within the selected shoppers’ profiles? Can students obtain anthropometric data of human heights to design for reach? What is the minimum distance between to objects within a space to safely move in between and not cause disruption to the flow? How about reaching out into the table tops and trying out the audio equipment? What if a person on wheelchair needs to navigate the space?. This kind of questioning, not only allowed students to step away from the hard technical requirements of the space, but think about how it will be used from human centred perspective. Placing themselves in the shoes of the buyers, shoppers, by passers, and curios shoppers, are there things that can be done to make their experience appeasing, pleasant and intuitive.

From a marketing and brand perspective – other ideas emerged amongst the discussions; How can the characteristics of a population close to the retail store to target be identified? Is it possible to transform linguistic messaging and communications into a better,

more highly visual, impactful symbol of meaning, How is it possible to reduce words and promote other communicative techniques that are more globally understood through design language? Does iconography, associative cultural cues and semiotics have a role in this ? This really allows the student to think about certain shapes, curvatures, points in space and placement of design features in a more meaningful and cohesive manner. Something that strikes the emotional chords of the potential buyers and represented organisations alike within a free for all environment.

Across the eight weeks of delivery, each of these disciplinary areas were prepared for content, probing these questions and passing them out between the cohort, industry collaborators and academics involved – to inspire, question, and very importantly, try to open new areas in the students minds for them to find their motivations and potentially specialise within, upon them raising their independent enquiry.

With this ethos, these questions encouraged the students to move beyond purely visual or commercial considerations and consider more responsible design principles, including accessibility, inclusion and the equitable participation with a more diverse user background in mind within retail environments. Equitable business performance, equitable user needs and how they can be met, equitable decision making across all disciplines typically involved in a spacial design objective.

Predefined Models vs. Abstract Modelling

Computer Based Design Models supplied to them, contained predefined constraints, geometric features, sizing information, colour

material finish, as well as methods of manufacture and assembly; fixtures, fittings, centre of mass, etc) based on 12 audio equipment systems. The CAD itself usually constructed by sequentially adding parametric sketches and applying CAD operations (Rukhovich et al, 2025) were accessible by the students, to understand structure, order, and hierarchy of the audio equipment's physical features. Stored in the SharePoint cloud, students were given access to these product thanks to the industrial collaborators. One of the companies that design this equipment was more than happy for the students to extract key geometric information and accommodate their retail space to promote the sales of these products. That is a key purpose of this challenge. Alluring customers, educating potential buyers, and providing informative points of sales within the space and positioning them appropriately, and effectively is inhibit within the challenge of this brief.

These predesigned assets contained geometric data points for students to access and imprint into their ideas throughout their design process. This method of collective transformative learning, enable students to create new knowledge and practices within an existing system. Coined recently as Expansive Learning studies have shown its benefits and relevance in industry-orentied learning particularly useful within the systems thinking paradigm (Novoa Munoz & Parulekar Prasad Hari, 2025).

On the otherhand, students were given the freedom to navigate and synthesise an open 200 page guideline documents from the collaborators, containing rather less tangible bits of knowledge. Elements that are implicit, that need synthesis and interpretation. Information, related to graphical layouts, tone of voice, brand imagery, visual balance, proportionality, marketing assets, cognition

guidelines and essentially everything related to human appeal, and touchpoints representing meaning. Principles that students could use to guide their conceptual ideas of any sensory touch points they want to create. Understanding brand, layering, and visual management. Much of these interpreted as abstraction points create a less controllable challenge for students. The challenge is to try and make sense of these.

The categorisation shown below, explains how the students were encouraged to explore computer-based model information evolving around tangible CAD assets, and other elements within the resources provided containing abstract knowledge – where extraction, in interpretation is needed by the students and their individual personal background and sensitivities and awareness.

Structured	*Abstract*
CAD Geometry	**Brand Values**
Dimensions	**Emotional Triggers**
Assembly	**Experience Touchpoints**
Materials	**Perception Enhancements**
Manufacture	**Marketing& Promo**
Constraints	**Semiotics, Tone, Storytelling**

Table 1 Above showing structured, predefined models supplied early in the project, vs, abstract, ongoing modelling based on information supplied and student's interpretations.

On the left, structured knowledge accessible through simple analysis of 12 audio equipment models provided. On the right, abstract knowledge requiring students to identify, collate and synthesis personalised versions of what they can interpret - explicit, tacit, geometric, symbolic, experiential and commercial knowledge

purposely under defined for students to free roam and make their own remarks upon.

For example, CAD geometry details are fixed well quantifiable and explicit requirements and specifications that students can simply refer to and reuse. Whereas 'experience touchpoints' for example, are fairly subjective to the perception of the student what they prioritise within the environment. Information in this regards had to be researched, analysed, somewhat made sensible, and decisions about it to be made and justifiable. Likewise, dimensions, assembly, material specs, manufacture specs and hard constraints are there to be used or reused, whereas Brand Values, Emotional Triggers, Perception Support, Tone, Story telling and so on, need to be researched, determined, development, elaborated, and decided on, before having to be justified and made for rationalisation for it to be brought into the attention of the audience or in this case, the organisations involved.

Our Approach to Shared Practices and facilitation of Student-Industry Engagement

Our approach presents a practice-based case study undertaken within a second-year undergraduate product design module at Brunel Design School. Over a period of eight-weeks, several types of activities were facilitated and enabled involving collaboration between Brunel University London and three UK industry partners each bringing in their own perspectives, perceptions, and insights into this brief.

The student cohort represented a diverse multidisciplinary learning environment, comprising students from Industrial Design, User Experience Design and Engineering Design programmes. Each

discipline contributed different forms of knowledge, methods and perspectives, allowing the design challenge to be approached from multiple viewpoints on top of the academic and industrial inputs. This sophisticated relationship between the stakeholders paved way to be more comfortable dealing with systems thinking, same challenge, different viewpoints. Seeing the different students learning journeys was more exciting this way.

This diversity reflected professional design practice, where responsible solutions increasingly require collaboration between individuals with different expertise, experiences and ways of understanding user needs. Concise commercial requirements were systematically expanded into multidisciplinary educational opportunities. Individual statements within each brief were decomposed into interconnected knowledge domains including industrial design, ergonomics, human factors, marketing, branding, responsible design, ethicality, manufacturing, spatial planning, digital interaction and user experience design.

The approach allows everyone involved, including the lecturers, administrators and so on, to treat knowledge without isolation. Forming truly intertwined mental models within a very simple at first design challenge. The negotiations of the wordings, terms, and hypothetical ideas thrown back and forth between the stateholders involved including the students meant that everyone was encouraged to push their thinking beyond disciplinary boundaries and to begin appreciating the variety of the knowledge sources, and diverse communication styles affiliated within certain areas of the discussions. In order to acquire practical knowledge, students had to

make sense of ideas, discussions, and remarks coming their way, all the time.

In addition, the module adopted an experiential learning approach, combining lectures, workshops, design reviews, independent research, iterative prototyping and regular feedback from both academic staff and industry representatives. Students progressively developed concepts through sketching, digital modelling, physical prototyping and presentational activities, allowing continual reflection and refinement throughout the design process. The academic's role faithfully shifted into the facilitator role, optimised to allow and promote students to navigate a more open ended unfamiliar space and prepare to be active within problem based learning experiences.As a result of the practices facilitated above, the students are believed to have acquired knowledge from several different sources to create a more accurate, holistic understanding of the industry brief requirements.

Figure 2 below visually represents this phenomenon. The students' awareness grows, based on the design decisions they have made, and being able to assign the source to the consequencesbeyond aesthetic and commercial success is factored in. Through engagement with the industry constraints, customer experience requirements and accessibility considerations, students were encouraged to recognise the relationship between design choices and user inclusion. This shift from designing objects towards designing experiences represents an important transition towards responsible design practice that is more holistic, and wholesome. Designers should not be afraid to step outside their areas of expertise and attain new skills.

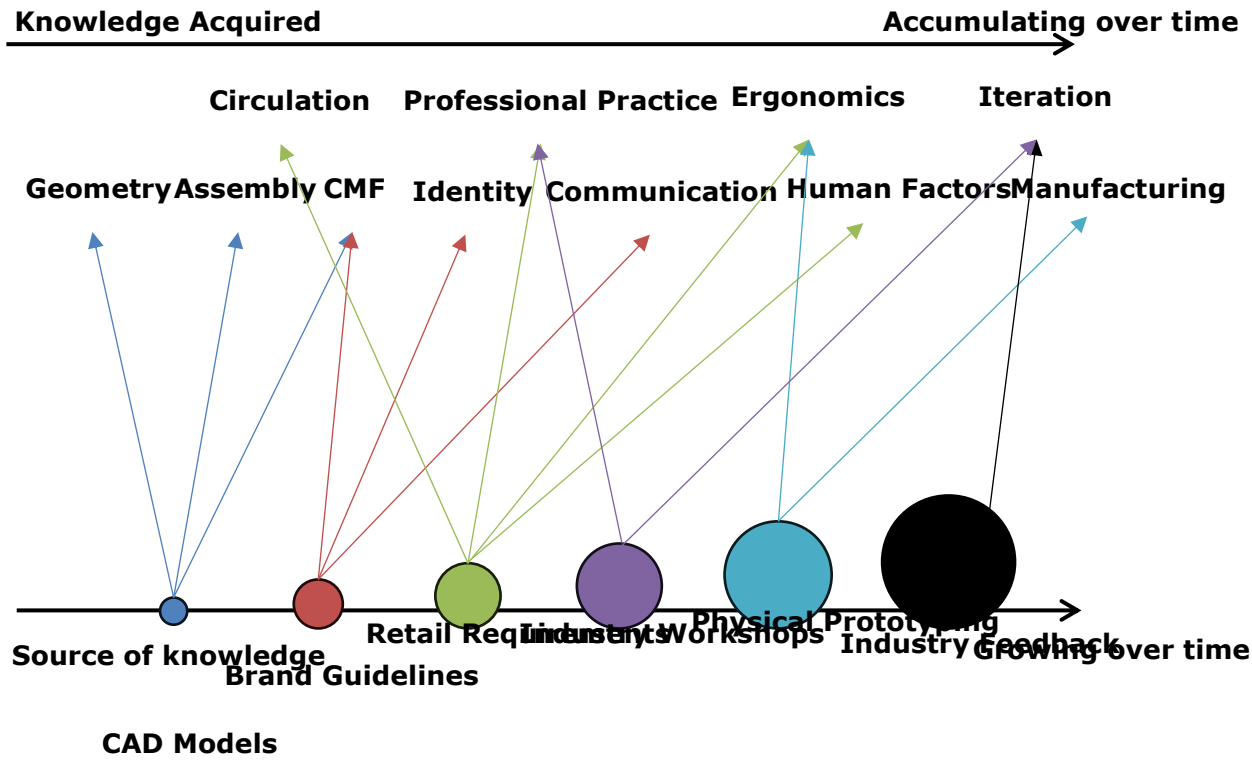


Figure 2 Above showing knowledge acquisition through computer-based design assets obtained from several different sources pointed out to the students as their experience grows over time.

Designers should follow a linear approach in accumulating the knowledge over a period, but also to consider an iterative, cyclic approach, where they may have to go back and update their knowledge to their latest thinking.

Outcomes

At the end of the module, when work was submitted, the difference of this approach harnessed significant results. First, several students were selected to exhibit their work to representatives from the United States educational visit. This was during a university showcase event

where the student's work was identified as 'remarkable'. The opportunity provided students with an opportunity to communicate and justify their design decisions to external audiences 'on the spot' and essentially were the mechanism to enhancing Brunel University's international profile amongst the visitors. Such exhibitions also create opportunities for wider collaboration in the future, demonstrating the value of industry-academic partnerships in supporting institutional reputation, future recruitment activities and external engagement towards are recognisable responsibilities towards a growth strategy.

The module also resulted in external recognition through national design competitions. One project was awarded the regional winner prizeentry, competing against 8 other universities in the UK also tackling a retail design challenge. The project was followed up with an invite to participation in a professional pitching event in Central London where concepts were presented to industry representatives and wider communities of practice from the prestigious world of retail. The experience allowed the student behind the project to further develop professional communication and presentational skill set in addition to engrossing into a more confident entrepreneurial spirit within a commercial environment that is beyond the university setting. As a result of their successful work, a prize award and certificate were also awarded.

In addition to the award itself, some students actively shared the project across professional social media platforms, creating narratives around the design process deployed - through posts, tagging collaborating organisations and engaging with wider design communities the student, university network and academic contacts circle was grown. Enhance the visibility of both individual work and

collaborative university-industry initiatives as alternative to traditional methods for CV job hunting can provide a shortcut to reaching active employers.

The experiential nature of the project also contributed to graduate employability. One student successfully secured a industrial internship with a design organisation located approximately one hour away from Brunel University London. A placement role for 12month was also offered. The work that was produced for this module helped develop the content for their portfolio in which during the recruitment process was viewed. More broadly, the remaining students incorporated the project into their own graduate portfolios, curriculum vitae and employment applications, using the experience to demonstrate their capability in responding to real life industry briefs, working with computer-based design assets (technically competent and managerial operations) and communicating multidisciplinary design thinking to prospective employers.

Altogether, these outcomes demonstrate that industry-oriented collaboration supported by computer-based design resources can extend learning beyond the classroom, providing students with opportunities for external recognition, professional networking, employment and portfolio development.

Equally, the collaborations strengthened relationships between academia and industry, enhancing opportunities for future partnerships while contributing positively to the university's reputation and producing graduates capable of responding confidently to real-world design challenges.

It is also important to note that the case presented in this paper demonstrates how generative AI focused mostly on its use for supporting the human thinking. The core driver behind the project, developing of the solutions, and the knowledge attainment was driven by students. Successful outcomes can be achieved through critical thinking, navigation around the complex requirements of the brief, and at the same timeuse of AI tools can be more useful within enquiry-based learning, questioning and act as more of a clarification seeking tool to support reaching a meaningful and sensible output.

Conclusions

This paper has presented an approach for transforming industry-led design challenges into multidisciplinary experiential learning opportunities within undergraduate design education. By expanding concise commercial briefs into interconnected disciplinary themes, students were encouraged to independently explore technical, human-centred and commercial dimensions of design. The integration of authentic industrial collaboration, iterative prototyping and experiential pedagogy enabled students to develop specialist knowledge and broader professional competencies that they can then take with them to harness success and gain even more recognition within the creative industry.

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