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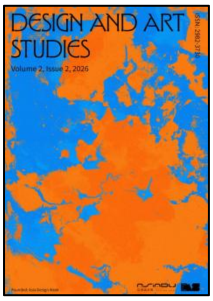

Case Studies / Practice Reports

Design as Curriculum Logic in Interdisciplinary Engineering Education: A Comparative Documentary Study of Four International Cases

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Abstract

Engineering education reform increasingly invokes design as a means of developing integrative, collaborative, and socially responsive capabilities. Yet design is often confined to a course, capstone, or project method, leaving its curriculum-level function undertheorized. This article examines how design becomes a recurring organizing logic in interdisciplinary engineering education through a comparative documentary study of four internationally visible cases: Singapore University of Technology and Design, UCL Engineering, Charles Sturt University Engineering, and Delft University of Technology. A theoretically sampled corpus of 19 peer-reviewed and official institutional documents was analyzed through four dimensions: curriculum architecture, the role of design, experiential progression, and institutional support. Within-case evidence matrices and cross-case pattern matching identified four primary pathways of institutionalization: an institutional-philosophy pathway, a curriculum-architecture pathway, a situated-practice pathway, and a capability-profile pathway. The comparison shows that design functions as curriculum logic when it is recurrent across the learning journey, progressively structured, integrated with technical knowledge, made visible in assessment and reflection, and sustained by organizational arrangements. The findings also distinguish design from project-based learning: projects provide an instructional format, whereas design contributes practices of problem framing, synthesis, iteration, stakeholder negotiation, and judgment under uncertainty. For China's New Engineering Education reform, the cases offer transferable mechanisms rather than models for direct replication. The article proposes a mechanism – condition framework for local curriculum diagnosis and reform while explicitly limiting its claims to documented curriculum intentions rather than demonstrated educational outcomes.

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1. Introduction

Engineering education is being reconsidered in response to technological acceleration, ecological transition, industrial change, and the growing complexity of socio-technical problems. These pressures have exposed the limits of curricula organized mainly around the transmission of disciplinary knowledge and the solution of well-bounded technical problems. Engineers increasingly need to work across professional, organizational, cultural, and disciplinary boundaries while retaining technical depth (Graham, 2018; Kamp, 2023; Van den Beemt et al., 2020). In China, this concern is articulated through New Engineering Education (NEE), which calls for curriculum renewal, closer relations between universities and industry, and new forms of interdisciplinary capability formation (Wei, 2022; Zhuang & Xu, 2018).

Within this reform agenda, design is frequently presented as a means of fostering creativity, integration, and responsiveness to complex problems, yet its curricular role remains undertheorized. Existing work often locates design in discrete courses, capstones, or project-based activities. Less attention has been paid to how design can organize relationships among disciplinary knowledge, experiential learning, assessment, and institutional support across an entire program. This gap is especially relevant to China's New Engineering Education, where ambitious policy goals must ultimately be translated into coherent curriculum structures and durable institutional arrangements.

The study addresses two questions: (1) Through what curricular and institutional mechanisms is design embedded across four contrasting international cases of engineering education reform? (2) What principles and boundary conditions can these cases offer for design-oriented reform within China's NEE context? The article contributes a transparent documentary comparison, a four-pathway typology, and a mechanism–condition account of design as curriculum logic. It does not rank the institutions or claim that their documented curricula produce equivalent learning outcomes. Its purpose is explanatory: to identify different institutional levers through which broadly similar ambitions are organized.

2. Literature Review and Conceptual Framework

2.1 Design, Project-Based Learning, and Curriculum Integration

Design occupies an important but ambiguous position within this reform landscape. Engineering education research has long recognized the value of design projects, open-ended problem solving, and project-based learning (Dym et al., 2005). Design can require students to frame problems, move between analysis and synthesis, generate and evaluate alternatives, make decisions under uncertainty, and consider human and social consequences (Buchanan, 1992; Cross, 2006; Schön, 1983). Nevertheless, many curricula still locate design in a discrete module, a final-year capstone, or a late-stage prototyping activity. In those arrangements, design may enrich a course without altering how knowledge and experience are organized across the program.

The distinction matters because curriculum integration is not achieved simply by adding projects or interdisciplinary content. Integrated curricula require deliberate relations among goals, knowledge, teaching activities, assessment, institutional resources, and the contexts in which students learn (Froyd & Ohland, 2005; Lattuca & Stark, 2009). Reviews of interdisciplinary engineering education similarly show that educational vision, teaching practices, and institutional support are interdependent; authentic problems and teamwork are valuable, but their effects depend on assessment, coordination, infrastructure, and sustained program design (Spelt et al., 2009; Van den Beemt et al., 2020). What remains less explicit is how design participates in this program-level organization.

2.2 From Design Activity to Curriculum Logic

This article uses the term curriculum logic to describe that broader role. The concept does not imply that every course becomes a design studio. Rather, it asks whether design practices and judgments organize recurring relations among disciplinary knowledge, experiential learning, collaboration, assessment, and professional formation. This shifts attention from the quantity of design content to the mechanisms through which design becomes institutionally consequential.

Three levels of design in engineering education can be distinguished. At the content level, design appears as a subject, studio, project, or body of professional knowledge. At the method level, it provides practices such as problem framing, research, ideation, modeling, prototyping, testing, iteration, and reflection. At the level of curriculum logic, design shapes how those practices recur and develop across time, how they connect to technical learning, and how they are supported and assessed. The third level includes the first two but cannot be inferred from the presence of a design course alone.

For this study, design was treated as curriculum logic when documentary evidence indicated four properties. First, design-oriented activity was recurrent rather than episodic. Second, it progressed in complexity, autonomy, or contextual exposure. Third, it was connected to disciplinary learning rather than operating as an extracurricular supplement. Fourth, it was made consequential through assessment, reflection, governance, resources, or external partnerships. These properties translate the broad idea of an academic plan into observable curricular relations (Lattuca & Stark, 2009).

This definition also separates design from adjacent concepts. Project-based learning is an instructional format; it can organize activity around a project without necessarily asking students to redefine the problem, synthesize competing forms of knowledge, or negotiate stakeholders and consequences. Interdisciplinary learning concerns the integration of disciplinary perspectives; it can occur through research, seminars, or analytical work without a design process. Design may combine both, but its distinctive contribution lies in purposeful movement from an uncertain situation toward an argued and revisable intervention (Cross, 2006; Dym et al., 2005; Schön, 1983).

3. Methods

3.1 Research Design and Unit of Comparison

This study adopted a comparative documentary case-study design. Documents were treated as data that record institutional intentions, curriculum structures, and publicly articulated educational mechanisms (Bowen, 2009). The unit of comparison was not each university in its entirety, but the dominant mechanism through which design-oriented learning was organized at the curricular level represented in the available evidence. This distinction was necessary because the four cases operate at different scales: a design-centered university, a faculty-wide integrated program, a specialized work-integrated engineering program, and a distributed project and capability ecosystem within an established technical university.

3.2 Case Selection and Documentary Corpus

The cases were selected theoretically rather than statistically. Graham’s (2018) international review provided the initial case pool. From that pool, cases were retained when they (a) offered explicit evidence of curriculum-wide design, experiential, or interdisciplinary organization; (b) were documented through both scholarly and official institutional sources; and (c) increased variation in institutional age, scale, delivery model, and reform strategy. The resulting sample was designed for maximum analytical contrast, not representativeness. Table 1 summarizes the comparison logic.

The core documentary corpus comprised 19 sources: one cross-case report, four sources for SUTD, five for UCL Engineering, five for CSU Engineering, and four for TU Delft. It was assembled through citation chaining from Graham (2018), targeted searches for case-specific scholarly literature, and review of official institutional websites. Collection and verification were completed in July 2026. Sources were included when they directly described at least one analytical dimension, were peer reviewed or institutionally authoritative, and contained sufficient curricular detail to support a coded claim. Duplicate pages, brief promotional items without curricular substance, and unsupported claims of educational effectiveness were excluded from the core corpus. Supplementary Table S1 lists every document and its analytical role.

Table 1. Case selection and comparative logic.

Case	Institutional contrast and focal unit	Core corpus	Theoretical sampling rationale
SUTD	New design-centered university; university-wide undergraduate curriculum	4 documents	Shows design embedded through institutional identity and a common educational philosophy.
UCL Engineering	Established research-intensive faculty; Integrated Engineering Programme	5 documents	Shows faculty-wide reform through common curricular infrastructure across disciplinary degrees.
CSU Engineering	New civil engineering program; blended and work-integrated delivery	5 documents	Shows design logic organized around projects, on-demand technical learning, placements, and portfolios.
TU Delft	Established technical university; distributed program and learning-ecosystem evidence	4 documents	Shows design linked to a T-shaped/resilient graduate profile and project culture.
Cross-case source	Graham’s international review	1 document	Provides the initial internationally visible case pool and common point of comparison.

3.3 Analytical Framework and Procedure

Analysis proceeded in four stages. First, a deductive codebook organized evidence under curriculum architecture, role of design, experiential progression, and institutional support (Table 2). Second, source-linked evidence matrices were prepared for each case, with separate fields for stated curriculum intention, documented mechanism, and evidential limitation. Third, within-case memos identified the dominant institutional lever and plausible rival interpretations. Fourth, cross-case pattern matching was used to develop pathway labels and test them against disconfirming evidence. The labels are therefore ideal types: each names the dominant lever in the available record, while acknowledging that an institution may combine several pathways.

Table 2. Analytical codebook.

Analytical dimension	Guiding question	Documentary indicators
Curriculum architecture	How are knowledge and experience sequenced and connected across the program?	Common versus disciplinary components; cross-year progression; project cadence; curricular interfaces; assessment location.
Role of design	What function does design perform?	Course content; project method; problem framing; synthesis; iteration; human/social context; curriculum-wide organizing principle.
Experiential progression	How do students move from abstract knowledge toward situated practice?	Challenges; studios; placements; capstones; portfolios; reflection; increasing complexity, autonomy, and stakeholder exposure.
Institutional support	What makes the arrangement sustainable beyond individual instructors?	Governance; timetable coordination; faculty collaboration; spaces; digital platforms; accreditation; external partnerships; staff workload.

3.4 Trustworthiness and Scope of Claims

Several safeguards were used to strengthen interpretive rigor. Claims were checked across source types wherever possible; peer-reviewed accounts were used to contextualize institutional descriptions; and current webpages were treated as time-bound records rather than stable representations of historical practice. Most importantly, institutional documents were interpreted as evidence of intended or formal curriculum, not as proof of classroom enactment, student experience, or learning effectiveness. The analysis was not independently replicated by a second coder, so the source inventory, codebook, and evidence matrices are provided as an audit trail rather than as a claim of inter-coder reliability. Tables 1 and 2, together with Supplementary Tables S1–S3, provide the documentary audit trail for the analysis.

4 Findings

4.1 SUTD: Institutional-Philosophy Pathway

Singapore University of Technology and Design (SUTD) represents the clearest case in which design is positioned as an institutional philosophy. Established in 2009, SUTD was organized around a broad "Big-D" conception that treats technologically enabled design across products, systems, services, architecture, and human contexts as a shared field of inquiry (Magee et al., 2013). This framing differs from an established engineering school that later adds design modules: design is part of the university's identity, vocabulary, and expectations for undergraduate formation.

The curriculum evidence shows recurrence across different scales. Telenko et al. (2016) describe "designettes," compact challenges that connect disciplinary content with design activity within a class, across courses, or across fields. Current Freshmore materials retain a common first-year foundation spanning science, mathematics, technology, humanities, social sciences, and design, while the 2026 curriculum further integrates design and artificial intelligence across all three first-year terms (SUTD, 2026). Design accreditation across undergraduate programs provides another institutional signal that design competence is expected beyond a single major (SUTD, n.d.).

The dominant lever is therefore institutional philosophy: a shared account of what education is for shapes common curriculum, repeated design encounters, and program recognition. Its main transfer condition is demanding. A philosophy becomes curricular only when governance, staffing, scheduling, assessment, and facilities repeatedly enact it. SUTD's greenfield origin helped align those elements; an established university cannot reproduce the pathway merely by adopting the language of design. Figure 1 summarizes the recurring multi-scale design experiences described in the documentary record.

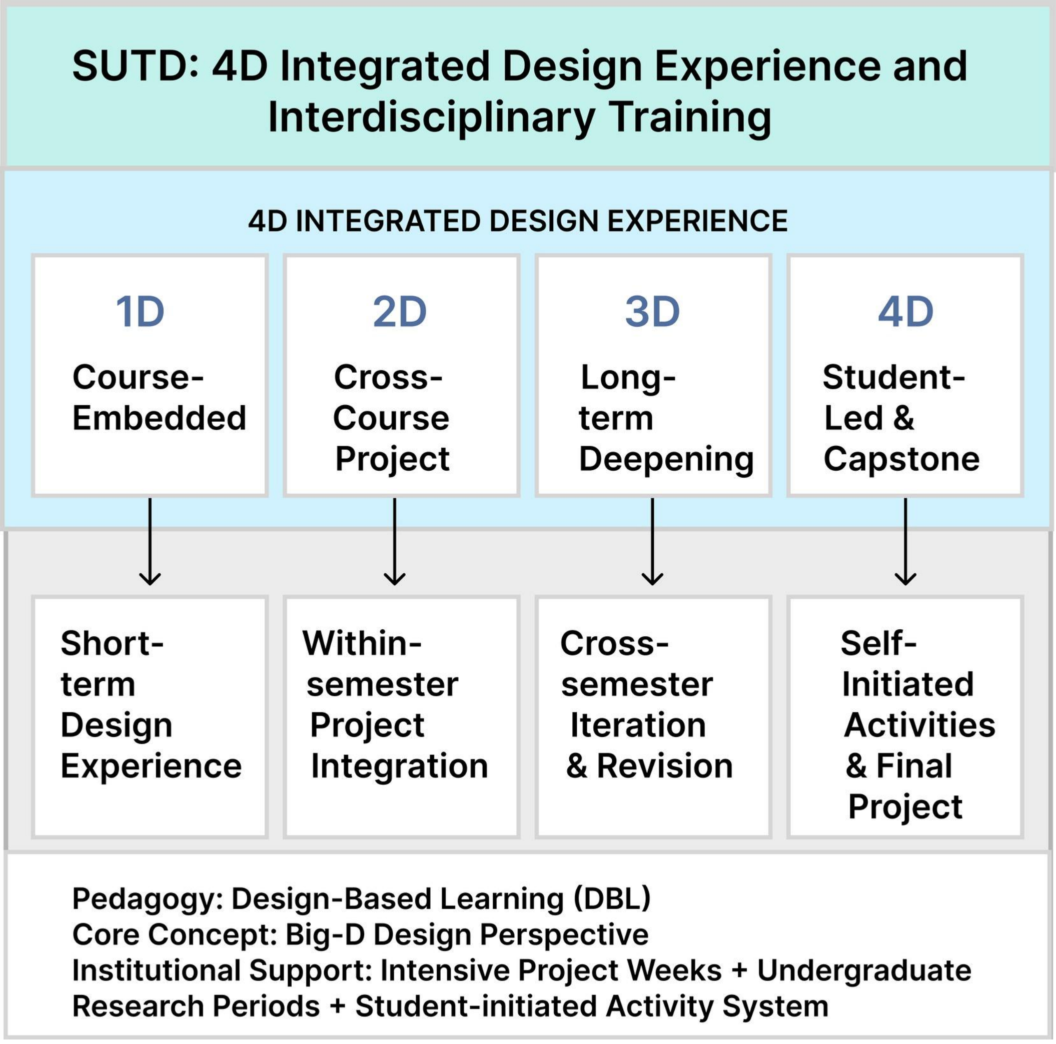

Figure 1. SUTD: 4D Integrated Design Experience and Interdisciplinary Training

Note. Author-generated synthesis based on Magee et al. (2013), Telenko et al. (2016), and Singapore University of Technology and Design (n.d., 2026).

4.2 UCL Engineering: Curriculum-Architecture Pathway

UCL Engineering's Integrated Engineering Programme (IEP) illustrates reform through curriculum architecture. Unlike SUTD, UCL introduced a common framework across an established, research-intensive faculty while preserving disciplinary degree programs. The IEP uses a root-and-branch structure: students retain technical specialization but encounter shared project-based and professional learning that connects departments and stages of study (Mitchell et al., 2019; UCL Engineering, n.d.-b).

Design is woven through this connecting infrastructure. Engineering Challenges introduces first-year students to two five-week projects, supported by mathematical modeling and Design and Professional Skills modules. Scenario Weeks provide intensive discipline-based project experiences, while interdisciplinary minors and the later How to Change the World activity extend the range of contexts in which students collaborate and make design judgments (UCL Engineering, n.d.-a, n.d.-c, n.d.-d). The significant feature is not any single project. It is the planned relation among projects, disciplinary modules, professional skills, ethical and social contexts, and increasing student autonomy.

The dominant lever is curriculum architecture: design becomes a connector across a large faculty because common elements are positioned at specific points in the learning journey. This pathway depends on cross-department governance, timetable coordination, staff participation, and assessment alignment. It also permits local variation, which is an advantage but creates a boundary condition: the common framework must remain coherent enough to avoid becoming a loose collection of departmental projects. Figure 2 summarizes the common curricular infrastructure and progressive learning logic.

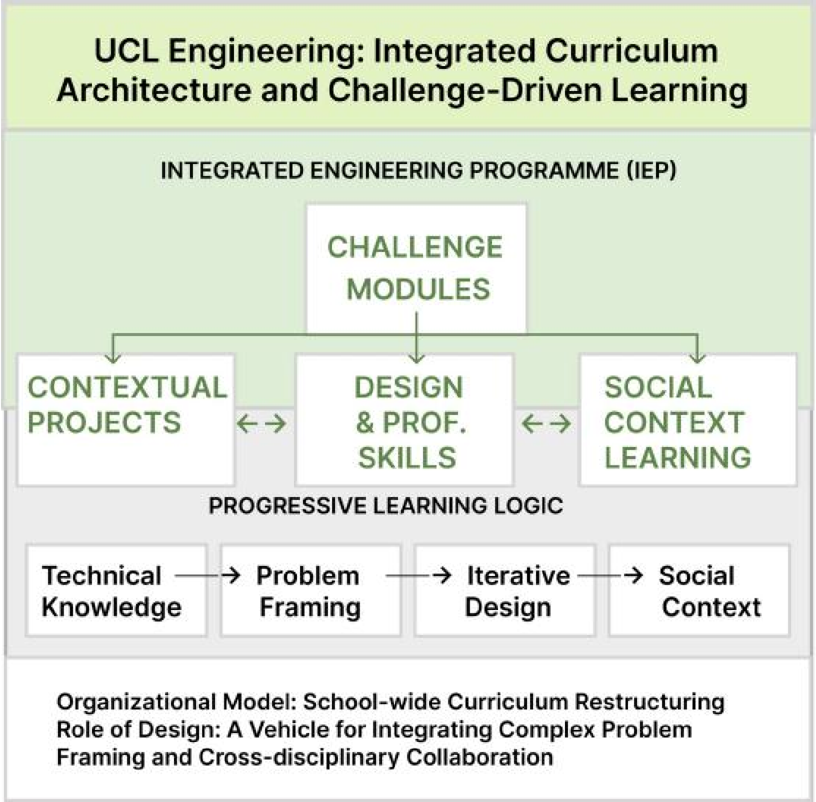

Figure 2. UCL Engineering: Integrated Curriculum Architecture and Challenge-Driven Learning

Note. Author-generated synthesis based on Mitchell et al. (2019) and UCL Engineering (n.d.-a, n.d.-b, n.d.-c, n.d.-d).

4.3 CSU Engineering: Situated-Practice Pathway

Charles Sturt University Engineering (CSU Engineering) organizes learning around movement between campus projects, online technical study, workplace practice, and reflective evidence of capability. The original program, established in 2016, combined semester-long project challenges with extended paid industry placements and continued online study (Lindsay & Morgan, 2021; Morgan et al., 2021). Although program structures evolve, current handbook materials continue to document the two mechanisms most relevant to this analysis: the Civil Engineering Topic Tree and placement-linked professional portfolios (Charles Sturt University, 2026a, 2026b).

The Topic Tree decomposes the technical curriculum into approximately 1,000 connected topics and uses a mastery-learning structure. Students select and complete knowledge in relation to prerequisites, project demands, workplace needs, and identified gaps. The portfolio sequence asks students to use industry experience to evidence graduate attributes, integrate technical knowledge with practical problems, communicate to different audiences, and reflect on professional development. Design is therefore not confined to studio activity. It appears in the relation between an authentic situation, just-in-time learning, engineering synthesis, action, evidence, and reflection.

The dominant lever is situated practice. Curriculum decisions are organized around contexts in which knowledge must be mobilized rather than around a fixed sequence of conventional subjects alone. The pathway depends on the quality and continuity of placements, digital curriculum infrastructure, academic and workplace supervision, and students' capacity for self-directed learning. These dependencies are not incidental; they are the institutional conditions that make the model possible and the principal risks when it is transferred. Figure 3 summarizes the relationship among the Topic Tree, campus projects, workplace learning, and portfolio-based reflection.

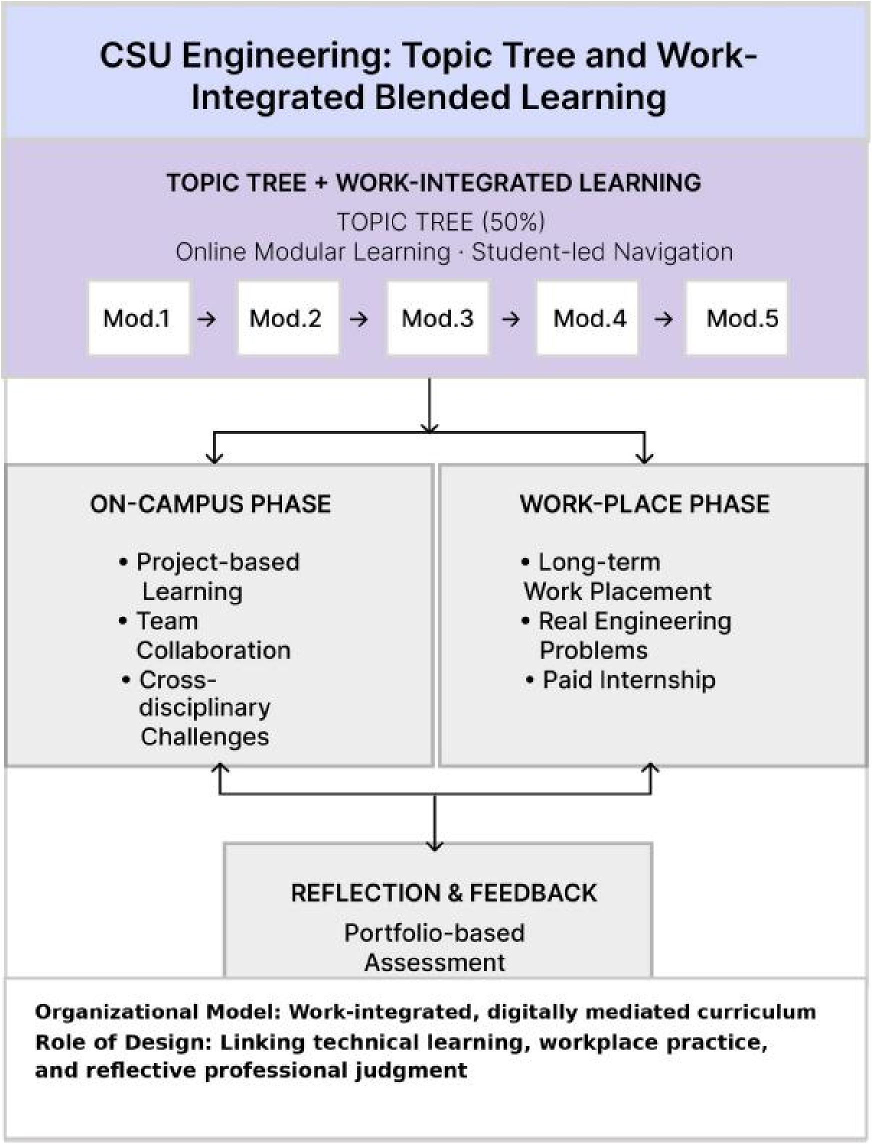

Figure 3. CSU Engineering: Topic Tree and Work-Integrated Blended Learning

Note. Author-generated synthesis based on Lindsay and Morgan (2021), Morgan et al. (2021), and Charles Sturt University (2026a, 2026b).

4.4 TU Delft: Capability-Profile Pathway

The TU Delft case is more distributed than the other three and should not be read as a single university-wide curriculum. The documentary record instead links a long-standing project culture, program reconstruction, and a changing account of the engineer's professional profile. Kamp (2023) argues for graduates who combine disciplinary depth with the ability to work across domains and respond to rapidly changing contexts. Earlier curriculum reconstruction work in Aerospace Engineering similarly used the T-shaped professional as a reference point for connecting technical specialization, design projects, and professional capability (Kamp & Klaassen, 2013).

Project-based learning provides a recurrent mechanism. In Aerospace Engineering, first-year design-and-construction work has been used to connect technical knowledge with hands-on design, teamwork, and interdisciplinary skills (Schuurman & Rans, 2022). More recent accounts describe a broader learning ecosystem that includes multidisciplinary and reflective projects, new interdisciplinary master's programs, and central projects involving external stakeholders (Klaassen et al., 2024). Here, design serves less as a uniform institutional identity than as a practice through which intended graduate capabilities become visible.

The dominant lever is the capability profile: curriculum elements are justified by the kind of engineer the institution seeks to form. The pathway's strength is that interdisciplinarity does not replace technical depth; it extends the contexts in which depth can be applied. Its limitation is diffusion. Because evidence comes from multiple programs and initiatives, implementation may vary across faculties. Transfer therefore requires program-level alignment between the declared graduate profile, project sequence, assessment, and the resources that support interdisciplinary work. Figure 4 summarizes how project-based learning supports the relationship between disciplinary depth and cross-domain capability.

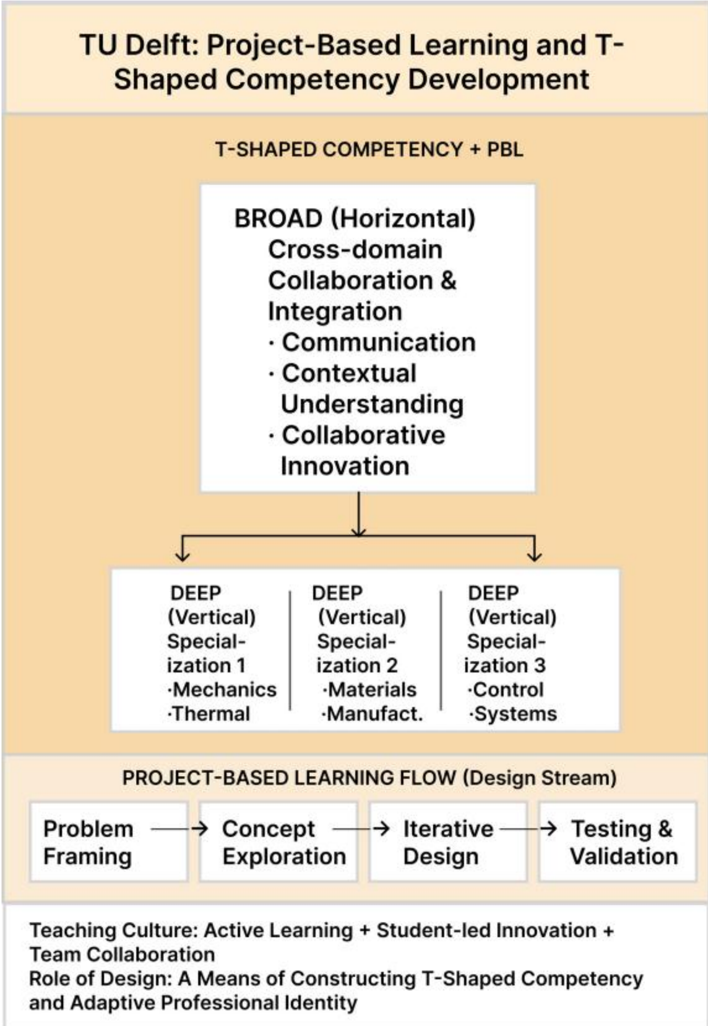

Figure 4. TU Delft: Project-Based Learning and T-Shaped Competency Development

Note. Author-generated synthesis based on Kamp (2023), Kamp and Klaassen (2013), Schuurman and Rans (2022), and Klaassen et al. (2024).

4.5 Cross-Case Synthesis

Across the cases, design is institutionalized through four primary levers: institutional philosophy, curriculum architecture, situated practice, and capability profile. These are not mutually exclusive categories. SUTD also uses curriculum architecture; UCL articulates a philosophy; CSU forms capabilities; and TU Delft relies on institutional support. The typology identifies the lever that is most explanatory in each documentary record, not an exclusive institutional identity.

The comparison also reveals a common pattern. Design becomes curriculum logic when students encounter it repeatedly, when experiences develop rather than repeat at the same level, when projects require the mobilization of technical knowledge, and when learning is made consequential through assessment and reflection. Institutional support is present in different forms: common governance at SUTD, faculty-level coordination at UCL, digital and workplace infrastructure at CSU, and program or ecosystem alignment at TU Delft. Figures 1 – 4 summarize the case-specific configurations, while Table 3 compares their mechanisms, enabling conditions, and transfer risks.

The cases therefore do not support a single best model. They suggest that curriculum reform begins from different institutional starting points. A new university may align identity and structure from inception. A large faculty may need common curricular infrastructure. A work-integrated program may use authentic settings as the main organizer. An established technical university may begin from an intended graduate profile and build project ecosystems around it. In each case, the value of design lies in the relations it creates, not simply in the number of design-labelled courses.

Table 3. Cross-case synthesis of pathways, conditions, and transfer risks.

Pathway	Primary lever	Recurring mechanisms	Enabling conditions	Principal transfer risk
Institutional-philosophy (SUTD)	Institutional identity and shared educational purpose	Common curriculum; recurrent design challenges; broad design framing; design accreditation	Governance, shared language, staffing, facilities, assessment coherence	Adopting the rhetoric of design without aligning structures and resources
Curriculum-architecture (UCL)	Faculty-wide curricular infrastructure	Challenges; design and professional skills; scenarios; minors; interdisciplinary capstone	Cross-department coordination, scheduling, shared assessment principles	Fragmentation into loosely connected departmental projects
Situated-practice (CSU)	Authentic professional contexts	Project challenges; Topic Tree; placements; portfolios; reflective evidence	Workplace partners, digital infrastructure, supervision, student self-regulation	Uneven placement quality or weak connection between online knowledge and practice
Capability-profile (TU Delft)	Intended graduate profile	Design projects; disciplinary depth; interdisciplinary ecosystems; stakeholder engagement	Program alignment, project culture, assessment of professional capabilities	Aspirational capability statements without consistent curricular enactment

5 Discussion

5.1 Design Is More Than Project-Based Learning

The findings clarify why the presence of projects is insufficient evidence that design functions as curriculum logic. A project can be tightly specified, assessed mainly for technical correctness, and isolated from later learning. Design becomes more consequential when students must frame the situation, integrate heterogeneous constraints, develop and compare alternatives, test consequences, and justify revisions. Project-based learning supplies a temporal and organizational format; design supplies a mode of inquiry and judgment. The distinction is important because otherwise any project-rich curriculum can be described as design-led without showing what students actually learn to do.

The four cases also indicate that design's curriculum-level role is relational. It connects analytical knowledge with action, disciplinary depth with boundary crossing, and technical feasibility with ethical, organizational, environmental, and human considerations. This supports the three-level distinction introduced earlier: design as content can be added locally, design as method can change a course, but design as curriculum logic changes the progression and alignment of the program.

5.2 Pathways as Mechanism–Condition Configurations

The pathway typology should be read as a set of mechanism–condition configurations. Each pathway activates design through a different institutional lever, but none operates independently of enabling conditions. An institutional philosophy requires governance and a common educational language. Curriculum architecture requires coordination and aligned assessment. Situated practice requires dependable external partners, supervision, and digital support. A capability profile requires a progressive project sequence and clear links between intended outcomes and assessment.

Across the four pathways, design practices—framing, integrating, iterating, collaborating, and reflecting—become curriculum logic only when they acquire curricular properties of recurrence, progression, technical integration, and assessment alignment. Institutional enablers then sustain those properties over time. This mechanism–condition account explains both the promise and fragility of design-oriented reform: visible projects may be introduced quickly, but durable curricular relations depend on organizational work that is less visible and more difficult to maintain.

5.3 Implications for China's New Engineering Education

For NEE, the cases are most useful as diagnostic resources rather than templates. The first task is to identify the institution's available leverage point. A new interdisciplinary college may be able to begin from philosophy; a mature engineering school may need to redesign common curriculum infrastructure; a regional university with strong industry relations may organize learning around work contexts; and a research-intensive university may begin with a future-oriented graduate capability profile.

A locally grounded reform process can then proceed through five linked decisions. First, define the design capabilities that graduates should demonstrate and distinguish them from general creativity or presentation skills. Second, map where problem framing, synthesis, iteration, collaboration, and reflection currently occur across the program. Third, construct a progressive design spine rather than relying on a single capstone. Fourth, align assessment, faculty workload, scheduling, spaces, digital platforms, and external partnerships with that spine. Fifth, evaluate enactment through student work, interviews, observations, and learning outcomes rather than assuming that formal curriculum documents describe practice.

Contextual translation is particularly important in China because NEE is implemented across institutions with very different missions, disciplinary cultures, regional industries, and resources. The international cases demonstrate mechanisms, but the problems, stakeholders, professional expectations, and institutional constraints should be locally defined. A curriculum that treats design as an imported vocabulary without changing assessment or organizational relations is unlikely to produce sustained reform. Conversely, local projects and industry engagement can remain pedagogically narrow if students are not asked to frame problems, examine social consequences, and reflect on competing forms of value.

The framework also suggests a research agenda. Future work should test whether the four pathways appear in a broader and less positively selected sample, examine hybrid or failed configurations, and compare intended curriculum with enacted and experienced curriculum. In the Chinese context, longitudinal studies could investigate how design-oriented reforms interact with accreditation, faculty incentives, industry partnerships, and students' disciplinary identities.

6 Limitations

This study has five principal limitations. First, it relies on documentary evidence. Official pages and program descriptions are useful for analyzing formal curriculum, but they may present institutions strategically and cannot show how students or teachers experience implementation. Peer-reviewed case accounts reduce but do not remove that limitation. Second, the cases differ in scale and documentary density. SUTD and UCL provide relatively coherent institutional narratives, whereas the TU Delft evidence is distributed across programs and initiatives. The typology therefore compares dominant mechanisms, not equivalent organizational units.

Third, the sample is theoretically and positively selected from internationally visible reforms. It is well suited to identifying contrasting possibilities but not to estimating prevalence or average effectiveness. Less resourced institutions, unsuccessful reforms, and non-English documentation are underrepresented. Fourth, curricula evolve. The analysis combines historical scholarship with webpages verified in July 2026; some relationships may have changed between publication and retrieval. Fifth, the coding and pathway construction were not independently replicated by a second coder. The supplementary corpus, codebook, and source-linked matrices improve transparency, but the categories remain interpretive abstractions.

Accordingly, the study does not establish causal effects on learning outcomes, compare institutional performance, or empirically validate the proposed NEE principles in China. Interviews, classroom observation, student-work analysis, longitudinal program evaluation, and outcome data are needed to test how the identified logics are enacted and with what consequences.

7 Conclusion

This comparative documentary study shows that design can become more than a course or project method in engineering education. Across four contrasting cases, it is institutionalized primarily through an educational philosophy, a shared curriculum architecture, situated professional practice, or an intended graduate capability profile. The pathways differ, but each depends on recurring and progressively structured design activity, integration with technical knowledge, assessment and reflection, and durable institutional support.

The central contribution is therefore not a model to copy, but a way to diagnose curriculum reform. Design functions as curriculum logic when it reorganizes relationships among knowledge, action, collaboration, context, and professional judgment across the learning journey. For China's New Engineering Education, the practical question is not how many design courses to add. It is which institutional lever can support a coherent design spine, what conditions must be built around it, and how its enactment will be evaluated in the local context.

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Acknowledgments are omitted from the anonymized manuscript for double-blind review.

Ethics Statement

Ethics approval was not required because this study analyzes published literature and publicly available institutional documents and does not involve human participants, experimental intervention, or identifiable personal data.

Availability of Data and Materials

The core documentary corpus, inclusion criteria, analytical codebook, and source-linked evidence matrix are provided in the accompanying supplementary material. All underlying documents are publicly available through the references and URLs cited in the manuscript.

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Conflict of Interest Statement

The author declares no conflict of interest.

AI-Assisted Tools Disclosure

Generative AI-assisted tools were used during manuscript revision to support language editing, structural refinement, document formatting, and the technical preparation of author-generated schematic figures. The author independently verified all sources, factual claims, analyses, interpretations, and final wording and assumes full responsibility for the manuscript.

References

Bowen, G. A. (2009). Document analysis as a qualitative research method. Qualitative Research Journal, 9(2), 27–40. https://doi.org/10.3316/QRJ0902027

Buchanan, R. (1992). Wicked problems in design thinking. Design Issues, 8(2), 5–21. https://doi.org/10.2307/1511637

Charles Sturt University. (2021). Charles Sturt University Engineering Program successfully adapts to COVID-19 disruptions.https://www.csu.edu.au/sustainability/sustainable-development-goals/success-stories/2021/charles-sturt-university-engineering-program-successfully-adapts-to-covid-19-disruptions

Charles Sturt University. (2026a). Civil Engineering Topic Tree — Student Engineer (ENG271). Charles Sturt University Handbook. Retrieved July 15, 2026, from https://handbook.csu.edu.au/subject/2026/ENG271

Charles Sturt University. (2026b). Engineering Portfolio — Consolidating (ENG491). Charles Sturt University Handbook. Retrieved July 15, 2026, from https://handbook.csu.edu.au/subject/2026/eng491

Cross, N. (2006). Designerly ways of knowing. Springer.

Dym, C. L., Agogino, A. M., Eris, O., Frey, D. D., & Leifer, L. J. (2005). Engineering design thinking, teaching, and learning. Journal of Engineering Education, 94(1), 103 – 120. https://doi.org/10.1002/j.2168-9830.2005.tb00832.x

Froyd, J. E., & Ohland, M. W. (2005). Integrated engineering curricula. Journal of Engineering Education, 94(1), 147–164. https://doi.org/10.1002/j.2168-9830.2005.tb00835.x

Graham, R. (2018). The global state of the art in engineering education. Massachusetts Institute of Technology. https://www.rhgraham.org/resources/Global-state-of-the-art-in-engineering-education---March-2018.pdf

Kamp, A. (2023). Engineering education in the rapidly changing world: Rethinking the vision for higher engineering education (2nd rev. ed.). TU Delft. https://doi.org/10.59490/mg.71

Kamp, A., & Klaassen, R. (2013). Making curricular change: Case report of a radical reconstruction process. In Proceedings of the 9th International CDIO Conference (pp. 1–17). CDIO.

Klaassen, R. G. (2018). Interdisciplinary education: A case study. European Journal of Engineering Education, 43(6), 842–859. https://doi.org/10.1080/03043797.2018.1442417

Klaassen, R. G., Hellendoorn, J., & Bossen, R. H. (2024). Transforming engineering education in learning ecosystems for resilient engineers. IEEE Transactions on Education, 67(1), 44 – 55. https://doi.org/10.1109/TE.2023.3303364

Lattuca, L. R., & Stark, J. S. (2009). Shaping the college curriculum: Academic plans in context (2nd ed.). Jossey-Bass.

Lindsay, E. D., & Morgan, J. R. (2021). The CSU engineering model: Educating student engineers through PBL, WPL and an online, on-demand curriculum. European Journal of Engineering Education, 46(5), 637 – 661. https://doi.org/10.1080/03043797.2021.1922360

Magee, C. L., Wood, K. L., Frey, D. D., & Moreno, D. (2013). Advancing design research: A "Big-D" design perspective. In A. Chakrabarti & R. V. Prakash (Eds.), ICoRD'13: Global product development (pp. 41–60). Springer India. https://doi.org/10.1007/978-81-322-1050-4_4

Mitchell, J. E., Nyamapfene, A., Roach, K., & Tilley, E. (2019). Philosophies and pedagogies that shape an integrated engineering programme. Higher Education Pedagogies, 4(1), 180 – 196. https://doi.org/10.1080/23752696.2018.1507624

Morgan, J., Lindsay, E., Howlin, C., & Van den Bogaard, M. E. D. (2021). The CSU Engineering Topic Tree: The first four years. Advances in Engineering Education, 9(3), 1–12. https://doi.org/10.18260/3-1-1153-73660

Schön, D. A. (1983). The reflective practitioner: How professionals think in action. Basic Books.

Schuurman, M. J., & Rans, C. D. (2022). Hands-on project based learning during lockdown—Lessons learned and what does the future hold? In AIAA SCITECH 2022 Forum (Article AIAA 2022-1351). https://doi.org/10.2514/6.2022-1351

Spelt, E. J. H., Biemans, H. J. A., Tobi, H., Luning, P. A., & Mulder, M. (2009). Teaching and learning in interdisciplinary higher education: A systematic review. Educational Psychology Review, 21(4), 365–378. https://doi.org/10.1007/s10648-009-9113-z

Singapore University of Technology and Design. (n.d.). Accreditation. Retrieved July 15, 2026, from https://www.sutd.edu.sg/education/accreditation/

Singapore University of Technology and Design. (2026). Freshmore subjects. https://www.sutd.edu.sg/education/undergraduate/freshmore-subjects/

Telenko, C., Wood, K., Otto, K., Elara, M. R., Foong, S., Pey, K. L., Tan, U.-X., Camburn, B., Moreno, D., & Frey, D. (2016). Designettes: An approach to multidisciplinary engineering design education. Journal of Mechanical Design, 138(2), Article 022001. https://doi.org/10.1115/1.4031638

UCL Engineering. (n.d.-a). How we teach. Retrieved July 15, 2026, from https://www.ucl.ac.uk/engineering/study/how-we-teach

UCL Engineering. (n.d.-b). Integrated Engineering Programme. Retrieved July 15, 2026, from https://www.ucl.ac.uk/engineering/centre-for-engineering-education/study/integrated-engineering-programme

UCL Engineering. (n.d.-c). IEP modules. Retrieved July 15, 2026, from https://www.ucl.ac.uk/engineering/centre-for-engineering-education/study/integrated-engineering-programme/iep-modules

UCL Engineering. (n.d.-d). What is the Integrated Engineering Programme (IEP)? Retrieved July 15, 2026, from https://www.ucl.ac.uk/engineering/centre-for-engineering-education/study/integrated-engineering-programme/what-integrated-engineering-programme-iep

Van den Beemt, A., MacLeod, M., Van der Veen, J., Van de Ven, A., van Baalen, S., Klaassen, R., & Boon, M. (2020). Interdisciplinary engineering education: A review of vision, teaching, and support. Journal of Engineering Education, 109(3), 508–555. https://doi.org/10.1002/jee.20347

Wei, S. (2022). New Engineering Education initiative of China: A policy debrief. In Proceedings of the ASEE Annual Conference & Exposition. https://peer.asee.org/new-engineering-education-initiative-of-china-a-policy-debrief.pdf

Zhuang, T., & Xu, X. (2018). "New Engineering Education" in Chinese higher education: Prospects and challenges. Tuning Journal for Higher Education, 6(1), 69–109. https://doi.org/10.18543/tjhe-6(1)-2018pp69-109