

# **MAKING SENSE BEFORE MAKING THINGS. BUILDING DESIGN RESEARCH LITERACY AND EPISTEMOLOGICAL AWARENESS IN FIRST-YEAR MASTER STUDENTS IN DESIGN**

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## **ABSTRACT**

This paper presents a pedagogical model developed within the MA Design for Sustainable Futures programme to introduce design research foundations to first-year master's students. The course Design Research & Methods, conceived in close relation to Design Studio, functions as an entry point to academic inquiry in design, supporting students in understanding how design generates, structures, and communicates knowledge, providing a research scaffold intended to inform early-stage studio work by strengthening problem framing, evidence use, and the articulation of design decisions. Placed at the start of the Master's path, it builds a shared research vocabulary and familiarises students with diverse epistemological and methodological approaches. Through an iterative trajectory—from defining design and knowledge production to framing research questions, selecting methods, and analysing data—students learn to navigate the design research process systematically and reflectively. Hands-on exercises (literature dataset building, mind mapping, and IMRAD-based writing) translate these principles into practical skills. The paper outlines the course design and reports diverse assessments grounded in students' experiences. Overall, the study examines how early exposure to design research competences may foster intellectual autonomy, critical thinking, and methodological awareness, supporting a research-oriented mindset for future challenges

*Keywords: Design research education, design epistemology, research literacy, design for sustainable futures*

## **1 INTRODUCTION**

The MA Design for Sustainable Futures (DfS) programme at KTU Kaunas University of Technology aligns with sustainability and circular-economy agendas, integrating design, management, and environmental engineering to develop systemic design and sustainability competences for products, services, and supporting systems. This responds to EU policy drivers framing circular economy as a pathway to redesign production–consumption systems [1] and linking the Green Deal to lived environments via initiatives such as the New European Bauhaus [2], as well as to the growing link between future competences, employment, and sustainability transitions [3]. Design is a core “green” capability, yet designers must demonstrate impact accountability and operate in interdisciplinary innovation settings [4]; accordingly, the programme adopts GreenComp as an overarching competence framework. Given the centrality of information and sources for problem framing and action, design research literacy is introduced early through the first-year course Design Research & Methods to help students navigate complexity, make evidence-informed sustainability claims, and articulate design as knowledge production. This also aligns with realities where design and R&D are intertwined in projects [5]. Design research can shape early problem framing and direction-setting in technological innovation [6], and designers can translate knowledge in R&D-oriented open innovation [7]. Building on this rationale, the paper evaluates whether—and how—these research competences change students' design approaches, examining perceived shifts in decision-making/accountability, problem framing, evidence use, and reflexivity, and contributing (i) a pedagogical model for early research foundations, (ii) an assessment based on end-of-course student perspectives, and (iii) implications for studio practice and inclusion through shared research vocabularies and methodological awareness.

## **2 BACKGROUND KNOWLEDGE**

### **2.1 Sustainability in education: from principles to actions**

Several research efforts have framed the key dimensions of sustainability competences [8] [9]. Among EU competence frameworks designed to embed EU value frameworks and inform members' educational systems, GreenComp is adopted here; it organises these capabilities into four “building blocks”: embodying sustainability values, embracing complexity, envisioning sustainable futures, and acting for sustainability [10]. These competences are increasingly critical given the climate crisis, biodiversity loss, and systemic social inequalities, which demand a paradigm shift beyond technological innovation alone, and in design and manufacturing sustainability has shifted from a “nice-to-have” to a mandatory requirement requiring agency to address wicked problems and make reasoned decisions [11]. To support competence development, Education for Sustainable Development (ESD) is increasingly discussed as a transformative learning process enabling responsible decisions for environmental integrity, economic viability, and social justice. UNESCO's “ESD for 2030” positions lifelong learning as a key enabler for all 17 SDGs and for transformations needed to remain within planetary boundaries [12]. Within this frame, research literacy is a foundational academic competency—data management, critical thinking, and evidence-based decision-making—supporting complex sustainability problem solving [9] [10]. Accordingly, ESD treats sustainability as a fundamental design requirement, demanding not only values but enactable competences expressed through concrete practices [13]; GreenComp defines these as the integrated mobilisation of knowledge, skills, and attitudes that enable empathetic and responsible thinking, planning, and action for the planet [10]. These competences are operational, shaping how students “do” design to restore ecosystem health and enhance justice rather than remaining declarative knowledge [14]. Organisational research similarly notes that action can be limited by “decoupling” (symbolic commitments not translating into practice) and cognitive dissonance (knowledge without agency or implementation skills) [10].

### **2.2 Bridging design research literacy with project-based learning for sustainability**

Design education is rooted in project-based studio learning where students “learn to design by designing” in a simulated professional environment [15]. These projects can foster sustainability competence through forward-looking thinking within a planetary consciousness paradigm [18], functioning as a “gym” for responsible innovation where futurable solutions align feasibility with planetary well-being. However, project-based learning does not automatically ensure epistemically robust sustainability action [16]: studios may privilege solution-oriented making while assumptions, systemic implications, and evidentiary bases remain under-scrutinised, leading to action without equal capacity to justify, validate, and situate interventions. Conversely, when sustainability is taught mainly as principles or content, students often struggle to translate ideals into reasoned decisions and project conduct [13]. To address this gap in a situated context, the study examines an instructional innovation within a specific curricular, institutional, and cultural setting where such integration had not been attempted, investigating how design research connects to early-stage project-based learning and related outcomes. An action research approach allows treating pedagogical advancement as a study of context-embedded change, generating practice-based insights through iterative implementation, while offering analytically transferable considerations beyond the immediate context [17].

## **3 FRAMING THE CONTEXT FOR ACTION RESEARCH**

### **3.1 The curriculum planning: Master's in design for Sustainable Futures**

Aligned with ESD purposes, the DfS programme was launched in 2025 to equip graduates with integrated knowledge across design, management, and environmental engineering, strengthening systemic design capabilities and sustainability competencies for future-oriented products, services, and supporting systems. It welcomes first-cycle graduates from diverse design domains and related disciplines, while requiring solid foundational design skills (composition, colour/aesthetics, visualisation, and software-supported project development). A distinctive curricular feature is the central role of design research as a bridge between project praxis and scientific inquiry [19], spanning design-based research (design as methodology) and design-oriented research (artefact as outcome), complemented when relevant by social science methods on industry and societal impacts. The pathway is organised into four thematic elements: Design Research (hands-on inquiry/experimentation), a “0-mindset” (mission-led systemic thinking, collaboration, impact anticipation, reducing planetary burdens, futuring), Hands-on Future (prototyping via traditional making and advanced digital

fabrication), and Interdisciplinary Knowledge (boundary-crossing integration for complex sustainability challenges). These elements align with the GreenComp “building blocks”, shaping a designer–sustainability expert profile and enabling students to address challenges across business, industry, nature/environment, and society, developing solutions for communities, ecosystems, industry, the city, and the university while opening opportunities for new directions in design research (Figure 1).

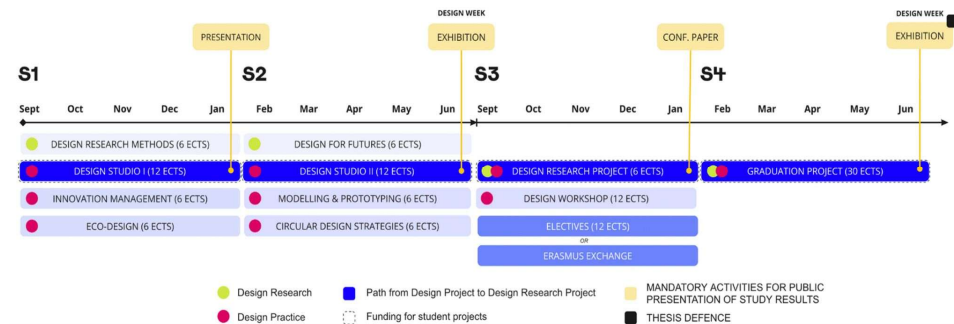


Figure 1. MA Design for Sustainable Futures programme path

This work evolves into a two-year design research project: it begins with a practice-driven design project in the first year and, in the second year, becomes an explicitly research-oriented endeavour in which the practical project is progressively merged with design research activities and outputs from the very beginning. A coherent learning trajectory—supported by sequential studio and research modules (more distinct in the first year and increasingly integrated in the second) and culminating in the final project—enables students to iteratively frame questions, select and apply methods, build evidence, and test interventions in laboratory and real-world contexts. The pathway prepares graduates for contributing to transitions through design-led action grounded in evidence-based practice.

### 3.2 The course design: Design Research & Methods

Within this framework, concerning specifically Design Research & Methods course, the authors adopted an iterative learning trajectory that is explicitly designed to feed into Design Studio 1, where students begin their first integrated, sustainability-oriented design project. The course progressively moves from foundational conceptual framing to applied research-design competencies that students mobilise in the studio. Learning activities were designed to translate abstract research principles into situated practice through a sequence of concrete exercises. The first phase defines design as knowledge production, situating it within broader epistemic paradigms (science–arts and “designerly” knowing) and introducing ontology, epistemology, and methodology to clarify what counts as knowledge and how it is generated in/through design. This grounding supports early studio work—sustainability challenge exploration, stakeholder/ context understanding, and sustainability-relevant intents—by helping students frame research problems and questions and treat inquiry as a structured yet non-linear, iterative cycle. The trajectory then addresses method selection so that data gathering becomes a decision-making resource for Design Studio 1. As a hands-on exercise, students conducted an initial literature search on their studio topic using library databases and scholarly repositories (i.e. Scopus), applied explicit inclusion criteria to build a coherent corpus, and recorded metadata and brief analytic notes to create a reusable dataset. This trained information seeking, critical judgement of relevance/quality, and literature organisation for framing, question formulation, and method selection. In parallel, students produced a mind map reconstructing key concepts from the introductory lecture on academic design research; together with the literature search, this formed the first assessment element, enabling evaluation of students’ articulation of an “academic design research logic” and identification of ambiguities or missing links. In the second phase, students then addressed method selection and its justification in relation to objectives, followed by data analysis, showing how analytical procedures transform “raw data” into evidence that can inform design directions and accountability claims within the studio process. The trajectory culminated in communicating knowledge, presenting research design as a blueprint including data presentation and reporting, operationalised through concise academic writing (i.e., an IMRAD-style abstract) to consolidate learning and train a transferable competence for more disciplined problem framings. Unlike the first phase, this stage relied on conversational reviews of students’ research process (no additional lectures) and focused on the second deliverable: an IMRAD-based speculative abstract.

Here, students reframed their Design Studio 1 project as academic design research, practising coherent communication of questions, methods, and emerging insights, and allowing teaching staff to observe their ability to “wear the design researcher’s glasses” when interpreting their own projects.

#### 4 METHODS FOR ASSESSING THE COURSE EFFECTIVENESS

This study adopts a qualitative course-evaluation design centred on students’ perspectives, using two sequential measurement points—a mid-term self-evaluation administered after the initial instructional block on design research foundations and process, and an end-of-course self-assessment—to trace perceived changes in research competence and their relevance for design practice. The two datasets were compared to examine perceived uptake and translation into “ways of designing” (framing, method choices, evidence-informed decision-making, reflective practice).



Figure 2. Mid-term students’ self-evaluation

Participants were first-year master’s students in Design Research & Methods; while sharing the National background, the cohort was academically and professionally diverse (i.e., Design Engineering, Graphic Design, Art Studies, Landscape Architecture, Business Analytics and Marketing, Multimedia Design), shaping differing familiarity with research language and practices. The mid-term self-evaluation (Figure 2) used a low-threshold dot-mapping across eight research design components (objectives & questions; data collection methods; sampling; instruments; data analysis; time frame & ethics; resources; data presentation & reporting) rated on a three-level colour scale (red/yellow/green), producing a readiness map used diagnostically and as an early reference point after the foundations block (not a true pre-course baseline) for comparison with end-of-course reflections on transfer. End-of-course data were collected via an anonymous Microsoft Forms survey on course organisation and personal reflections, eliciting open-ended narratives on links to students’ way of designing, connections to design tasks in Design Studio 1, and anticipated future integration. Data were analysed through thematic analysis and cross-time comparison: end-of-course responses were inductively coded for learning, the mid-term mapping was synthesised as a competence snapshot, and themes were compared to assess perceived shifts, persistent uncertainties, and evidence of research competences becoming enactable. The literature dataset with mind map and the speculative IMRAD abstract served as assessment artefacts and teaching evidence but were not systematically coded as a separate dataset; future work should analyse these artefacts to triangulate self-reported transfer.

#### 5 RESULTS

The cohort comprised 10 first-year students; the mid-term self-evaluation was completed by all students, the end-of-course survey by 6. The three open-ended questions were analysed through thematic analysis, with iterative reading, inductive line-by-line coding, and clustering into higher-order themes through repeated review and refinement. Themes are reported with a simple frequency indicator (number of respondents out of 6 contributing at least one coded excerpt); counts are non-exclusive because responses may include multiple themes, and they replace vague terms (i.e., “most”, “a minority”) with approximate denominators (i.e., 5/6; 1/6) without implying statistical inference. The mid-term self-evaluation indicates a differentiated competence profile: most ratings cluster in “partly clear” (yellow), with higher confidence for Research Objectives & Questions and Resources (more green), and lower confidence for Sampling (more red) and Data Analysis (mostly yellow, few green). Data Collection Methods and Instruments are intermediate, with mixed yellow/green and occasional red, suggesting

partial, procedural understanding. End-of-course thematic analysis suggests an overall positive but heterogeneous perceived transfer into students' "ways of designing", from foundational research literacy to research-to-design translation (i.e., "Through this course, I learned that design is not only about creating a product, but about understanding the decision-making processes, perceptions, and constraints that influence whether a product is adopted"). Foundational gains concerned information practices (locating reliable sources, keyword scanning, structuring knowledge via databases and mind mapping) to manage complexity. More operationally, students described research supporting framing and question formulation, shifting from solution-first exploration to a more deliberate inquiry logic (i.e., "From this course, I would incorporate a more structured research approach... define the problem... identify stakeholders... formulate focused research questions"), and, where concrete examples were provided, informing material and construction decisions under sustainability constraints and stakeholder logics. Interpreted through the programme's GreenComp positioning, these examples indicate that research literacy supported the *enactment* of sustainability competences rather than only generic "better research" skills. In particular, students' reported shifts toward systemic reframing of constraints and stakeholders ("embracing complexity") and toward evidence-informed material and construction trade-offs ("acting for sustainability") make the sustainability framing empirically visible within the reported transfer to Design Studio 1. A minority reported limited or delayed transfer due to insufficient opportunity to "really design" or difficulty integrating research practices within demanding studio workflows, indicating that timing and curricular coupling condition how readily competences become enactable. The two assessment points differ in format and construct: the mid-term instrument captures self-perceived clarity/confidence via a three-colour scale across predefined research components, while the end-of-course survey elicits retrospective, situated narratives of learning and transfer. Therefore, the datasets are not treated as directly commensurable measures of "change" but are related through analytic alignment: the mid-term mapping provides a competence snapshot after the foundations block, and end-of-course narratives are analysed for application, persistent uncertainty, or barriers in the same domains (framing, method choice, analysis-to-decision links). Cross-time comparison maps end-of-course themes and excerpts onto mid-term component areas to interpret progression, persistence, or friction, while acknowledging self-report limits and instrument non-equivalence. Read alongside the end-of-course survey, the mid-term profile offers a baseline for students' subsequent calls for more hands-on practice, particularly in sampling and data analysis, which appear most fragile at mid-course. The two assessment points indicate a shift from partial clarity—especially in procedural components—to end-of-course accounts where many students report using the course framework for problem framing, question formulation, and evidence-informed decisions. However, the comparison shows that perceived competence does not translate uniformly into practice: transfer depends on opportunities for application and on the alignment between research and design activities, helping explain persistent uncertainties and variable impact. In GreenComp terms, these accounts most directly point to 'embracing complexity' and 'acting for sustainability': students used research practices to relate material choices, stakeholder systems, constraints, and longer-term implications rather than treating sustainability as a general value statement.

## 6 CONCLUSIONS

In conclusion, this paper presented an iterative pedagogical model that introduces design research literacy and epistemological awareness at the start of a sustainability-oriented master's programme, proposing that "making sense before making things" can strengthen responsible action in project-based learning. End-of-course reflections suggest a shift from foundational research literacy (source discernment and knowledge structuring) toward research-to-design translation, where framing, question formulation, and evidence-informed decisions become more visible in studio work. However, transfer was uneven and could be delayed when research practices were weakly coupled with studio timelines, highlighting the need for curricular alignment and scaffolded opportunities for application. Research literacy thus functions as enabling infrastructure for accountability, critical thinking, and reflective iteration in sustainability-driven design, but the exploratory, self-reported dataset limits claims: despite the framing that sustainability competences should be enactable rather than declarative, the evidence captures only perceived development and declared transfer, not verified enactment in outcomes. Future work should triangulate self-reports with studio artefacts, process documentation, observational data, and longitudinal follow-up, and refine the course through more hands-on method workshops and tighter integration with studio milestones. A further implication concerns the sustainability–design research

relationship: sustainability may not require a wholly “different” paradigm, but it increases epistemic demands, so studio work benefits from research approaches that make framing, method choice, and evidence-building explicit to articulate trade-offs and accountability beyond solution-led making. Consistent with the course’s scaffold role, this specifies the contribution to sustainability-oriented design education: research literacy supports more situated, evidence-informed, and accountable sustainability claims.

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