DISC Concept:
Design Based Collaborative Research

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Table of Contents

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1 Introduction to Design Based Collaborative Research (DBCR)

1.1 Why Do Research in DISC?

Research serves as the cornerstone of innovation, policy development, and educational advancement. In the context of the DISC project it is a strategic tool for generating new knowledge, addressing societal challenges, and informing the design of educational programmes that foster sustainability and collaborative entrepreneurship. Through research, DISC partners aim to co-develop academic approaches that solve real-world problems and cultivate interdisciplinary competencies for the future of work and education.

Our world is becoming increasingly complex. Knowledge is growing exponentially, and our education systems are already failing to impart the knowledge that is available.

At the same time, we need truly interdisciplinary approaches to develop innovations in complex subject areas such as sustainable development – for example, by combining natural sciences, social sciences, engineering and digital sciences – not only in academic fields, but especially at the interface between academia, industry and practice.

In our research and professional practice, we realised that increasingly fewer students were interested in science at all – not only in the context of an academic 'research' career, but also in terms of an empirically sound approach to practical developments. That is why the DISC approach aims not only to make teaching more attractive with the help of design thinking and concrete projects, but also to create awareness that we can only create innovation with logical and empirically sound approaches.

The following inventory for Design Based Collaborative Research represents an initial, expandable catalogue that the DISC community can draw on to initiate well-founded, interdisciplinary, empirically sound developments, whether as study projects or in industry-academia partnerships.

The DBCL inventory opens the topic of „Research“ in a very generic way – to attract aöso those student and learner groups which are not heading for academic research.

In its current state it is meant as a starting point for further inquiry – a kind of general overview and introduction. If a student of social science or engineering finds a basic concept interesting and logical (e.g. mixed methods or grounded theory) the inventory delivers a first approach which shall be further developed - also by the students themselves.

This way the DISC approach follows basic didactic patterns (from easy to difficult and simple to complex) and gives a basic introduction to research and empirical science. However, it also aims to creating an open learning and developing environment, thus following a mathetical approach to support learners in different learning contexts who need to back up their learning and developments.

1.2 What is Empirical Science?

At the heart of the DISC project lies empirical inquiry—knowledge derived from observation, experimentation, and structured analysis. Empirical science demands transparency, reproducibility, and critical reflection, attributes which are critical in education-focused DBCR. In DISC, empirical research underpins the validation of learning models and methods, ensuring they are grounded in evidence and capable of real impact.

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1.3 Quality Indicators in Research

The DISC consortium adheres to three key indicators to ensure research quality:

- **Objectivity**: Findings are evidence-based and free from researcher bias.
- **Reliability**: Research procedures and results are consistent across contexts.
- **Validity**: Tools and methods genuinely measure what they claim to.
  These indicators guide the DISC project's efforts in developing sustainable, modular education systems across diverse European regions.

Additional categories can be added in different contexts such as "Category consistency" and many more. However, the three categories can be considered as the most common indicators.

1.4 Types of Research in the DISC Framework

DISC employs a range of research types:

- **Basic Research** to frame theoretical underpinnings of education for sustainable development (ESD).
- **Applied Research** to test pedagogical interventions and tools within real classroom settings.
- **Action Research** to include educators and learners as co-researchers.
- **Design-Based Research (DBR)** as the overarching methodology, integrating theory with practice to support continuous educational innovation.

1.5 Research in Educational & Natural Sciences

Unlike the controlled environments of natural sciences, DISC operates within the complex, context-rich field of social and educational sciences. Research here is often interpretative, with the researcher embedded in the system. This mirrors the DBCR approach, where change is co-constructed with stakeholders and refined iteratively.

Engineering Research Characteristics

DBCR borrows from engineering research by focusing on design, testing, and optimisation. The DISC project reflects this in its module development processes, which blend educational theory with prototyping, user feedback, and iterative refinement across partner institutions.

1.6 Comparing Paradigms

The DISC research framework acknowledges three key paradigms:

- **Natural Sciences**: Experimental, explanatory, often quantitative.
- **Social Sciences**: Interpretative, qualitative or mixed methods.
- **Engineering**: Constructive, design-oriented.
  DISC situates itself at the intersection of the latter two, favouring design-based, participatory, and transformative approaches.

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2 Approaches to Empirical Research

2.1 Inductive Reasoning

Induction is a key process in DBCR and DISC alike: insights emerge from specific observations, such as learner behaviour or classroom interaction, and lead to broader pedagogical principles. DISC encourages bottom-up reasoning in identifying sustainable education solutions.

2.2 Deductive Reasoning

Complementing induction, deduction in DISC helps test theoretical models through hypothesis-driven experimentation. For example, a theory about collaborative learning effectiveness may be tested across partner universities, ensuring cross-contextual validity.

2.3 Abduction – The Third Way

The DISC methodology balances inductive and deductive logic while recognising their limitations—overgeneralisation in the former, oversimplification in the latter. The solution lies in embracing a third path: **abduction**.

Abductive reasoning is central to DBCR and DISC's methodology. It enables researchers to develop plausible explanations from surprising or incomplete data—a typical scenario in real-life educational settings. In DISC, this supports the creation of novel learning interventions and contextual responses.

2.4 Grounded Theory Introduction

Grounded theory, in which theoretical insights emerge from data through iterative coding, aligns with DISC's ethos. The approach supports understanding complex educational environments and contributes to the co-creation of knowledge among academic and non-academic partners.

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3 Connecting Research Modes to Design Thinking

Design Thinking, foundational to the DISC project, mirrors research reasoning processes:

- **Divergent Phases** (Induction, Abduction): Empathise, Ideate.
- **Convergent Phases** (Deduction): Define, Prototype, Test.
  DISC uses this alignment to promote creative, yet systematic, development of its modular courses.

3.1 Design Thinking as Research

Design Thinking within DISC is more than a creative tool—it is a research framework. Its human-centred nature, iterative cycles (Discover, Define, Develop, Deliver), and capacity to integrate rigour with flexibility, make it a powerful vehicle for developing impactful education solutions.

Research in Interdisciplinary Contexts

As a transdisciplinary initiative, DISC thrives on blending perspectives from education, design, engineering, and sustainability sciences. Shared language, openness, and collaborative knowledge construction are integral to its DBCR approach.

Understanding Complex Systems

The educational ecosystems within DISC are complex, adaptive, and dynamic. To address them, DISC uses systems thinking—modelling interdependencies between curriculum, learners, technology, and institutional environments to support systemic innovation.

Cybernetics and Research

Cybernetics informs DISC's approach to feedback and control within learning systems. DISC models the interplay of its modules, partner institutions, and student experiences as a self-regulating system, where feedback loops are used to refine and improve outcomes continuously.

3.2 Design Thinking in Action: Lateral and Linear Reasoning

DISC's use of Design Thinking supports both linear (deductive) and lateral (abductive) thinking. This duality allows for structured experimentation and imaginative problem-solving, crucial for developing adaptable and student-centred learning experiences.

Creating Innovation in Projects

Within DISC, innovation emerges through structured procedures: ideation, stakeholder co-design, iterative testing, and contextual adaptation. These are anchored in both design thinking and DBCR principles, ensuring relevance and sustainability across regional contexts.

Validation in DISC

The DISC project builds on methodologies adopting mixed-method validation strategies. Evaluation in DISC is formative and summative, focusing on process and outcome indicators across diverse learning environments.

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Methods in Complex Settings

Given its scope, DISC employs a mixed-methods approach—qualitative interviews, quantitative surveys, simulations, case studies, and collaborative prototyping. Participatory methods ensure stakeholder voices are central to the research process.

Why This Matters for DISC Participants

For DISC students, educators, and institutions, engaging in DBCR means developing critical thinking, navigating uncertainty, and designing resilient systems. It empowers them to act on evidence and innovate within complexity—essential skills for future changemakers.

Summary and Reflection

This introduction has outlined the theoretical and methodological foundations of research within DISC and DBCR: the types of reasoning employed, the integration of design thinking, and the importance of context-sensitive, interdisciplinary approaches. As DISC progresses, these principles will guide the co-creation of knowledge and innovation across European Higher Education.

4 AI and DBCR in DISC

AI plays a transformative role in DISC's research methodology. It functions as a partner in DBCR—enhancing pattern recognition, simulating learning outcomes, and supporting hypothesis generation. It extends human capacity for abductive reasoning by proposing novel insights and enabling real-time model iteration.

How AI Supports Abductive Reasoning

AI systems in DISC detect anomalies and complex correlations, offering explanations that challenge existing models. This strengthens abductive inference, enabling DISC researchers to explore new educational pathways and respond to unexpected learner needs with agility.

AI in the DBCR Methodology

In DISC, AI supports all stages of the DBCR cycle—ideation, testing, reflection, and redesign. It fosters **collaborative intelligence**, where human insight and machine learning converge to co-create educational systems that are sustainable, adaptable, and future-ready.

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5 Combining DBCR and DBCL

Research Methods Aligned with Design Thinking in Design-Based Collaborative Research (DBCR)

Introduction Design-Based Collaborative Research (DBCR) integrates the iterative and user-centred principles of Design Thinking with empirical research methodologies. Each phase of the Design Thinking process can be strengthened through targeted research strategies that both inform and validate design decisions. The following concept outlines exemplary and suitable research methods for each of the seven Design Thinking steps within the DBCR framework.

5.1 Understanding the Challenge and the Clients

Objective: Gain a comprehensive understanding of users, stakeholders, and contextual factors.

Recommended Methods:

- **Qualitative Interviews:** Semi-structured or narrative interviews to explore user needs, behaviours, and pain points.
- **Focus Groups:** Engage diverse stakeholders to identify shared challenges and perceptions.
- **Participant Observation:** Embedded observation to capture authentic behaviours in natural contexts.
- **Persona Development Tools:** Use persona canvas and empathy maps to synthesise user insights.
- **Desk Research:** Review of existing literature, reports, and best practices related to the challenge.

Rationale: These methods support empathic engagement and form the foundation for co-creation.

5.2 Defining the Problem

Objective: Synthesise research findings to formulate a clear and actionable problem statement.

Recommended Methods:

- **Thematic Analysis:** Identify patterns and themes from qualitative data to inform the problem framing.
- **Affinity Diagramming:** Group data and insights to recognise relationships and focus areas.
- **Problem Tree Analysis:** Explore root causes and effects to define the core problem.
- **Systems Mapping:** Visualise the complexity and interdependencies in the problem space.

Rationale: These methods help transition from raw data to a well-defined, evidence-based problem.

5.3 Ideating (Divergent Thinking)

Objective: Generate a broad range of creative and innovative ideas.

Recommended Methods:

- **Brainstorming Workshops:** Facilitated sessions to encourage free-flowing idea generation.
- **SCAMPER Technique:** Systematic prompts for ideation based on existing solutions.
- **Design Charettes:** Collaborative, intensive workshops drawing on interdisciplinary expertise.

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- **AI-Assisted Ideation Tools:** Use of generative AI or machine learning tools to expand the idea space.

Rationale: Supports abductive thinking and opens up multiple pathways before narrowing down.

5.4 Selecting Ideas (Convergent Thinking)

Objective: Prioritise and select the most promising ideas based on defined criteria.

Recommended Methods:

- **Multi-Criteria Decision Analysis (MCDA):** Evaluate ideas against a weighted set of criteria.
- **Dot Voting/Impact-Effort Matrix:** Simple, participatory methods for democratic selection.
- **Delphi Technique:** Structured expert consensus for idea validation.
- **Feasibility-Desirability-Viability Framework:** Assess ideas holistically in relation to user needs, technology, and business models.

Rationale: Ensures rigour and stakeholder involvement in idea selection.

5.5 Developing Prototypes

Objective: Build tangible representations of ideas to test and refine.

Recommended Methods:

- **Rapid Prototyping:** Create low-fidelity versions (e.g., sketches, models, mock-ups) for quick feedback.
- **Wizard of Oz Technique:** Simulate technology experiences without full development.
- **Storyboarding/User Journeys:** Visualise use cases and interactions to anticipate user experiences.
- **Usability Testing:** Assess ease of use, satisfaction, and fit for purpose in early prototypes.

Rationale: Promotes iterative experimentation and abductive learning cycles.

5.6 Upscaling TRL of Prototypes

Objective: Move from proof-of-concept to tested solutions with increasing technological readiness.

Recommended Methods:

- **Technical Validation and Simulation:** Use labs or controlled environments to refine functionality.
- **Pilot Studies:** Conduct real-world implementations in limited scopes to gather operational data.
- **Longitudinal Case Studies:** Track impact and performance over time.
- **Benchmarking:** Compare with industry standards or similar innovations.

Rationale: Ensures solutions are robust, scalable, and tested under realistic conditions.

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5.7 Market Analyses for Pitches and In-Depth Descriptions

Objective: Understand market context, readiness, and strategic positioning.

Recommended Methods:

- **SWOT/PESTEL Analysis:** Evaluate internal and external factors influencing adoption.
- **Competitor Analysis:** Study similar offerings to identify differentiation potential.
- **Customer Validation Surveys:** Assess perceived value, willingness to pay, and adoption potential.
- **Business Model Canvas/Lean Canvas:** Systematically structure and test business propositions.

Rationale: Bridges research outcomes with entrepreneurial strategies and market relevance.

5.8 Conclusion

Research within DBCR is dynamic and cyclical, mirroring the evolving nature of design challenges. The integration of appropriate methods in each phase ensures that both creativity and evidence underpin decision-making. This approach not only fosters innovation but also generates robust knowledge that can inform future practice and policy.

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6 Research Methods

6.1 Social Science

Here's a structured overview of representative **mixed methods approaches in social sciences**, organised into three key research clusters relevant to your DBCR and DISC context: **Desk Research**, **Quantitative Methods**, and **Qualitative Methods**.

6.1.1 Desk Research

a) Background/Rationale:
Desk research (also known as secondary research) involves collecting and analysing existing data, literature, and sources without direct fieldwork. It is often the starting point for identifying knowledge gaps, informing theoretical frameworks, and contextualising empirical findings in social science and design-based research.

b) Objectives:

- To map existing knowledge and conceptual frameworks.
- To identify trends, policies, or historical data relevant to the research topic.
- To refine research questions and support hypothesis development.

c) Advantages / Disadvantages Compared to Other Clusters:
Advantages:

- Cost-effective and time-efficient.
- Allows for comprehensive background understanding.
- Supports triangulation when combined with primary data.

Disadvantages:

- May lack relevance or specificity to current/local context.
- Limited control over data quality or methodology.
- Cannot generate new primary insights.

d) Example:
A DISC module development team conducts desk research on European ESD policy documents to identify best practices and policy alignment needs before designing an educational intervention.

e) Tools/Instruments:

- Academic databases (e.g., Scopus, JSTOR, ERIC)
- Open data portals (e.g., Eurostat, OECD)
- Institutional reports and grey literature
- Systematic literature reviews
- Meta-analyses
- Content analysis software (e.g., NVivo for documents)

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6.1.2 Quantitative Methods

a) Background/Rationale:
Quantitative research is rooted in the positivist tradition, aiming to measure variables objectively and test hypotheses using numerical data. It's widely used in educational settings to assess learning outcomes, validate instruments, or analyse correlations.

b) Objectives:

- To test theories or hypotheses through empirical measurement.
- To determine statistical relationships and causality.
- To generalise findings across populations (when applicable).

c) Advantages / Disadvantages Compared to Other Clusters:
Advantages:

- Enables statistical analysis and trend identification.
- Perceived as more "objective" and replicable.
- Useful for large-scale comparisons and evaluations.

Disadvantages:

- Often limited in capturing depth, nuance, or context.
- Rigid structure can overlook emergent insights.
- Assumes standardisation, which may not fit complex educational environments.

d) Example:
In DISC, a student survey measures the perceived effectiveness of a sustainability module across five partner universities, enabling comparison of learning gains.

e) Tools/Instruments:

- Online surveys (e.g., LimeSurvey, Qualtrics, Google Forms)
- Statistical analysis software (e.g., SPSS, R, Excel, Stata)
- Experimental designs (pre-test/post-test)
- Structured questionnaires and Likert scales
- Learning analytics platforms (e.g., Moodle data exports)
- Dashboards for visualising trends and indicators

6.1.3 Qualitative Methods

a) Background/Rationale:
Qualitative research focuses on understanding human experience, meaning-making, and social processes. It is deeply interpretative and is essential for exploring the "how" and "why" behind patterns observed in education, culture, and behaviour.

b) Objectives:

- To explore perceptions, behaviours, and contexts in depth.
- To generate grounded theory or themes directly from data.
- To support co-creation and participatory insights.

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c) Advantages / Disadvantages Compared to Other Clusters:
Advantages:

- Captures complexity, subjectivity, and lived experiences.
- Highly adaptable and responsive to context.
- Essential for developing theory and understanding meaning.

Disadvantages:

- Time-intensive and harder to replicate.
- May lack generalisability.
- Subject to researcher interpretation bias (if not reflexively managed).

d) Example:
A DISC partner conducts semi-structured interviews with educators implementing a design thinking module to understand their pedagogical shifts and student engagement outcomes.

e) Tools/Instruments:

- Interview guides and protocols (structured, semi-structured)
- Focus groups and observation protocols
- Thematic coding frameworks
- Audio/video recording and transcription tools
- Qualitative analysis software (e.g., NVivo, MAXQDA, ATLAS.ti)
- Reflexive journals and field notes

6.2 Nature sciences

Natural Sciences Research Clusters for DBCR and DISC

Background/Rationale: Design-Based Collaborative Research (DBCR), as promoted within the DISC context, seeks to integrate scientific rigour with iterative, user-centred innovation. Although often associated with social science and design methodologies, DBCR can gain substantial depth and robustness from the inclusion of natural science-based research approaches. Natural sciences provide frameworks for evidence validation, systematic experimentation, and modelling—making them especially valuable when dealing with technological prototyping, system behaviour, and environmental sustainability.

Objectives:

- To identify clusters of natural science research methods suitable for DBCR.
- To map these methods to the phases of design thinking.
- To enhance the methodological repertoire of design-based research teams by incorporating empirical, measurable, and repeatable approaches from the natural sciences.

6.2.1 Cluster 1: Experimental and Laboratory Research

Typical Methods:
- Controlled experiments (e.g. A/B testing, material testing)
- Randomised trials (where ethical and feasible)
- Sensory evaluation (e.g. human-computer interaction, usability)

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- Analytical chemistry/biochemistry for testing environmental or health effects

Applications in DBCR:

- Evaluating technical functionality of prototypes
- Testing interventions under controlled variables
- Assessing health, safety, or environmental impacts

Advantages / Disadvantages Compared to Other Clusters: Advantages: High internal validity; reproducible; precise control of variables. **Disadvantages:** Limited ecological validity; may lack user context or complexity.

Examples:

- Lab-based testing of energy-efficient materials
- Randomised control trials on learning tools

Tools/Instruments:

- Lab instrumentation (e.g. spectrometers, calorimeters)
- Environmental chambers
- Software for data logging and analysis (e.g. MATLAB, SPSS)

6.2.2 Cluster 2: Systems Modelling and Simulation

Typical Methods:

- System Dynamics Modelling
- Agent-Based Modelling (ABM)
- Finite Element Analysis (FEA)
- Computational Fluid Dynamics (CFD)

Applications in DBCR:

- Simulating the effects of proposed innovations in real-world scenarios
- Modelling resource flows, energy use, or system feedbacks
- Supporting decision-making through predictive modelling

Advantages / Disadvantages Compared to Other Clusters: Advantages: Enables testing of complex systems; scalable; low cost of iteration. **Disadvantages:** Assumes simplification; model accuracy depends on input quality.

Examples:

- Modelling urban mobility solutions
- Simulating the energy impact of smart homes

Tools/Instruments:

- Vensim, AnyLogic
- NetLogo (ABM)
- COMSOL Multiphysics, ANSYS

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6.2.3 Cluster 3: Environmental and Field Research

Typical Methods:

- Environmental impact assessments (EIA)
- Life Cycle Analysis (LCA)
- Field experiments and ecological surveys
- GIS-based spatial analysis

Applications in DBCR:

- Embedding sustainability research in eco-design or circular economy projects
- Validating environmental claims for market adoption
- Informing the problem space with systemic environmental insights

Advantages / Disadvantages Compared to Other Clusters: Advantages: High ecological validity; addresses real-world complexity; relevant for sustainability. **Disadvantages:** Lower control over variables; time- and resource-intensive.

Examples:

- Measuring carbon footprints of product lifecycles
- Mapping green infrastructure in urban environments

Tools/Instruments:

- GIS software (ArcGIS, QGIS)
- LCA tools (SimaPro, OpenLCA)
- Portable environmental sensors

6.2.4 Cluster 4: Quantitative Measurement and Instrumentation

Typical Methods:

- Sensor data collection and logging
- Instrumental monitoring (e.g., temperature, energy, biometrics)
- Digital logging of user behaviour and interaction patterns
- Data acquisition via IoT devices

Applications in DBCR:

- Generating empirical data from real-world settings
- Supporting usability studies with quantitative feedback
- Benchmarking product/system performance

Advantages / Disadvantages Compared to Other Clusters: Advantages: High-resolution data; objective and real-time; adaptable to various domains. **Disadvantages:** Requires calibration; data interpretation can be complex.

Examples:

- IoT-based environmental monitoring in smart buildings
- Tracking user interaction patterns with digital prototypes

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Tools/Instruments:

- Arduino, Raspberry Pi
- Wearable biosensors
- Data platforms (ThingSpeak, AWS IoT, Tableau)

6.2.5 Cluster 5: Statistical and Computational Analysis

Typical Methods:

- Descriptive and inferential statistics
- Multivariate analysis (e.g. PCA, regression modelling)
- Machine learning for pattern recognition or predictive analytics
- Meta-analysis for synthesising findings

Applications in DBCR:

- Deriving insights from user testing and validation surveys
- Supporting abduction through data-driven discoveries
- Enhancing interdisciplinary studies with robust datasets

Advantages / Disadvantages Compared to Other Clusters: Advantages: Scalable; supports generalisation; powerful with large datasets. **Disadvantages:** Requires high data quality; not always intuitive for design teams.

Examples:

- Analysing survey responses to refine personas
- Predicting usage trends for digital services

Tools/Instruments:

- R, Python (Pandas, scikit-learn)
- SPSS, SAS
- Data visualisation software (Power BI, Tableau)

6.3 Engineering Research Clusters for DBCR and DISC

Background/Rationale: Engineering research contributes to DBCR by providing structured, problem-solving approaches rooted in iterative development, optimisation, and implementation of technologies. Its focus on functionality, efficiency, and practical application aligns well with the prototyping and upscaling phases of design thinking. In DISC, where innovative product and system development is key, engineering methods serve to test feasibility and scalability.

Objectives:

- To provide methodological support for prototyping, validation, and implementation.
- To promote iterative design and technological development.
- To ensure solution robustness and technical viability.

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6.3.1 Cluster 1: Design and Technical Development

Typical Methods:

- Engineering design processes (CAD, simulation)
- Concurrent engineering
- Failure mode and effects analysis (FMEA)
- Morphological analysis

Applications in DBCR:

- Creating and refining product designs
- Assessing design risks and performance trade-offs
- Integrating stakeholder feedback into iterative design cycles

Advantages / Disadvantages Compared to Other Clusters: Advantages: Technically rigorous; structured workflow; focused on implementation. **Disadvantages:** Can overlook user context if not integrated with participatory methods.

Examples:

- Redesigning low-cost medical devices
- Developing modular urban mobility systems

Tools/Instruments:

- SolidWorks, AutoCAD, Fusion 360
- FMEA software (IQ-FMEA, APIS)
- TRIZ innovation tools

6.3.2 Cluster 2: Systems Engineering and Integration

Typical Methods:

- Model-Based Systems Engineering (MBSE)
- Requirements engineering
- Verification and validation (V&V)
- Interface definition and systems integration testing

Applications in DBCR:

- Structuring interdisciplinary system designs
- Ensuring compatibility and alignment of subsystems
- Supporting scalability and interoperability of prototypes

Advantages / Disadvantages Compared to Other Clusters: Advantages: Supports complexity management; integrates hardware/software perspectives. **Disadvantages:** Can be overly technical or documentation-heavy for agile projects.

Examples:

- Integrating IoT devices into smart housing solutions
- Ensuring system operability across transport modes

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Tools/Instruments:

- SysML, Enterprise Architect
- DOORS (requirements management)
- Test automation frameworks

6.4 Digital Sciences Research Clusters for DBCR and DISC

Background/Rationale: Digital science research brings computational, algorithmic, and data-centric approaches that enrich DBCR with capabilities such as modelling, simulation, real-time data integration, and AI-enhanced design support. In the DISC context, where digital transformation intersects with education, culture, and sustainability, these methods help scale and personalise innovation.

Objectives:

- To enable data-driven decision-making and real-time adaptation.
- To leverage digital technologies in prototyping, evaluation, and iteration.
- To support AI-enhanced ideation, modelling, and simulation.

6.4.1 Cluster 1: Human-Computer Interaction and UX Research

Typical Methods:

- Usability testing (lab and remote)
- Cognitive walkthroughs
- Eye tracking and clickstream analysis
- Think-aloud protocols

Applications in DBCR:

- Evaluating digital interfaces and tools
- Enhancing user experience in educational and civic tech
- Informing user-centred iteration of digital prototypes

Advantages / Disadvantages Compared to Other Clusters: Advantages: Direct user feedback; behaviourally anchored; iterative. **Disadvantages:** Limited to interface-level feedback; resource-intensive.

Examples:

- Testing navigation and usability of e-learning platforms
- Refining user flows in public service apps

Tools/Instruments:

- Morae, Lookback.io, Hotjar
- Figma/Adobe XD (prototyping)
- UX metrics dashboards (Google Analytics, Mixpanel)

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6.4.2 Cluster 2: Data Science and AI-Supported Research

Typical Methods:

- Data mining and clustering
- Predictive modelling and recommendation systems
- Natural Language Processing (NLP)
- Generative AI for design ideation

Applications in DBCR:

- Analysing large datasets to identify design opportunities
- Supporting abductive reasoning with pattern discovery
- Enhancing ideation and scenario modelling

Advantages / Disadvantages Compared to Other Clusters: Advantages: Handles complex, unstructured data; enhances creative phases. **Disadvantages:** Requires computational infrastructure and technical expertise.

Examples:

- Using AI to generate curriculum redesign ideas
- Predicting learning outcomes in adaptive learning systems

Tools/Instruments:

- Python (scikit-learn, GPT models)
- RapidMiner, Orange
- Jupyter notebooks, cloud-based ML platforms

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