DIGITAL EDUCATION FUTURES INITIATIVE CAMBRIDGE

CEDiR
Cambridge Educational Dialogue Research Group

Cambridge Guide to Educational Design-Based Research (EDBR)

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Introduction:

In education, we often know what we want to achieve, but we do not know the best way to achieve it. Educational Design-Based Research (EDBR) gives us a way forward. EDBR provides continuous investigation of optimal solutions through iterative processes of design, development, evaluation, and refinement of educational designs. However, implementing Educational Design-Based Research (EDBR) presents distinct challenges, including the range of different DBR terminologies, the need for multiple iterations which often takes time and resources and adapting to work closely with educational contexts that are often highly complex and fluid. EDBR is especially challenging for PhD research because, in the UK at least, this is usually not funded and of relatively short duration. This guide is extracted and synthesized from a collection of successful PhD theses using EDBR at Cambridge, details of which are provided in the appendix. It proposes a set of key EDBR terms and a basic model for the processes vital to successful EDBR.

Definitions: Educational Design-based Research (EDBR)

Educational Design-based Research (EDBR) is DBR in the context of education. EDBR aims at improving teaching and learning, always in collaboration with practitioners and stakeholders. EDBR is distinct from other research methodologies in that its focus is not only on explaining or understanding but on improving: it seeks to explain and understand how teaching and learning work in order to be able to improve teaching and learning. However, EDBR differs from most educational Action Research because its immediate focus is on theory not on development: it seeks to improve practice by developing a better theory of how practice works.

Some key concepts useful for successful EDBR are:

01 **Primary Generator:** the main driving force or the foundational idea that motivates the research. This often stems from either a specific problem or a theoretical perspective that the researchers aim to address or explore through their design.

02 **Exploratory Phase:** The process of developing the initial Design Framework involves a combination of empirical fieldwork and literature review.

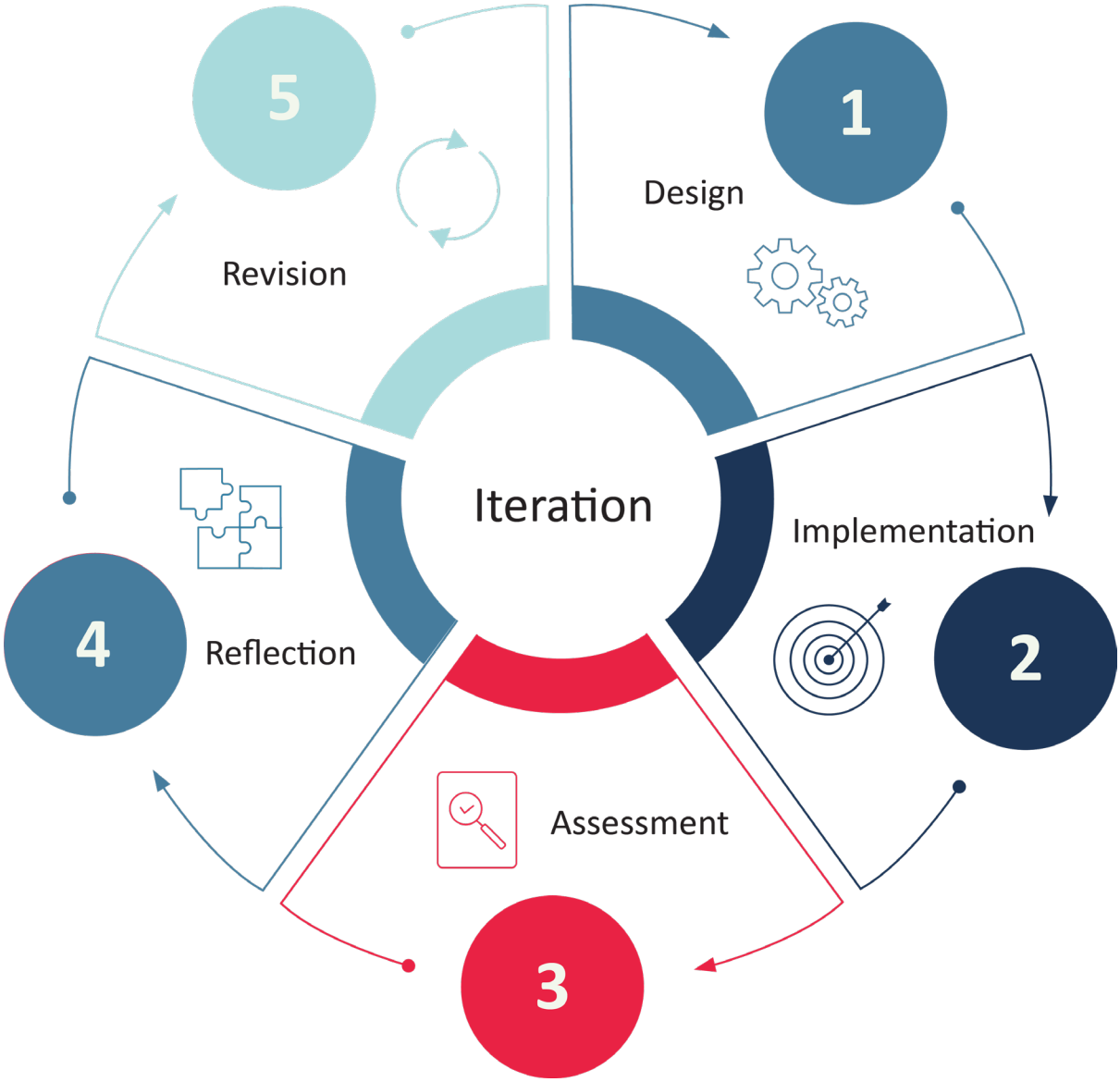
03 **Design Conjecture:** If I do X (e.g., teach or design environments in a specific way), then this will lead to more Y (the desired learning outcomes).

04 **Design Framework:** A collection of design conjectures assembled together to address a situated problem.

05 **Design Principle:** Design conjectures that have been tested and confirmed through the EDBR process. These principles constitute the body of knowledge (i.e., final design framework) that EDBR contributes and can be applied beyond the immediate context of the study to further educational contexts.

06 **Iteration:** The systematic process of refining and improving a proposed educational intervention through cycles of design, implementation, and assessment until it is found to be sufficiently effective.

Each iteration in DBR typically involves cycles with the following phases: Design; Implementation; Assessment; Reflection; and Revision.



01

Design: The researcher develops a new or revised Design Framework (DF) informed by findings from previous iterations (or exploratory research for the first DF) and literature.

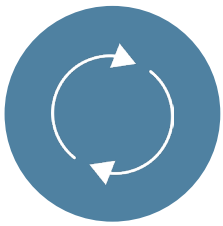
02

Implementation: The process of converting or operationalising the Design Framework into an actual teaching and learning practice (often in the form of interventions).

03

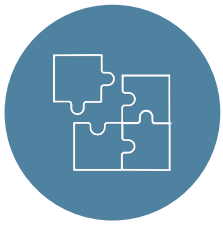
Assessment: The researcher evaluates the impact of the implemented Design Framework using various assessment tools, such as student learning data, observations, and interviews. This process includes both whether the design(s) work and how and why they work.

04



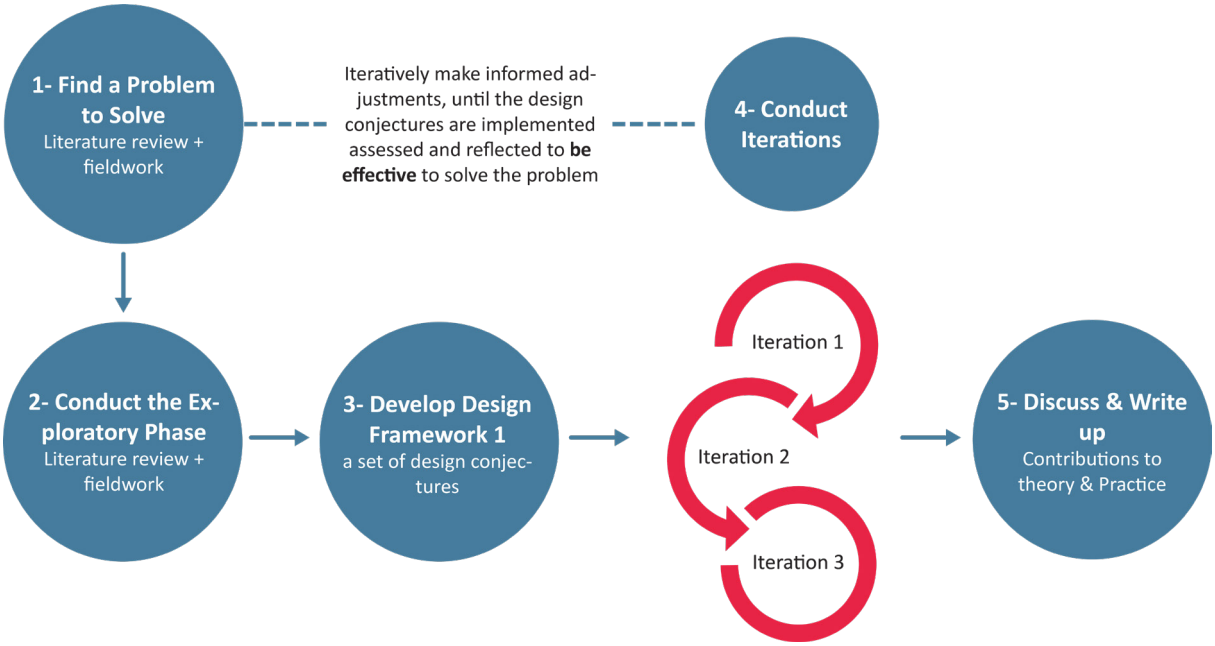
Reflection: The researcher analyses the assessment data and feedback from stakeholders to identify areas for improvement. It may also include the process of questioning and improving of the design aims to deepen the awareness of its purpose.

05



Revision [return to 1]: Based on the findings from the reflection stage, the researcher develops a new version of the Design Framework in preparation for the next iteration or, if it is the final iteration, for publication.

Step-by-step guide:



Step 1 Find a Problem to Solve - the Primary Generator

Start by pinpointing a significant, authentic problem in an educational setting. This problem will drive the research and design process throughout the EDBR (i.e., the primary generator).

Engage with stakeholders such as teachers, students, and administrators to ensure the problem is relevant and grounded in real-world educational practice.

Step 2 Conduct the Exploratory Phase: Literature Review + Fieldwork

Embark on a thorough literature review to establish a theoretical background for the EDBR. This review should help us understand previous work in the area, identify research questions, and guide the development of the design.

Complement this with fieldwork to gather data, such as interviews and observations, which will provide contextual insights for the study.

Step 3 Generate an Initial Design Framework with several Design Conjectures

Develop an initial design framework based on insights from the literature review and fieldwork. This framework should include several design conjectures – hypotheses about how particular design or teach will lead to learning and teaching improvements.

Ensure each design conjecture is both research-informed and feasible to implement in practice.

Step 4 Conduct Iterations

Implement the first iteration based on the initial design framework within a real-world educational setting. Collect data to assess its effectiveness and impact on teaching and learning. Analyse this data to refine the design framework into an updated version.

Repeat this process iteratively and make informed adjustments, until the design conjectures are provisionally confirmed as design principles, resulting in the final design framework.

Step 5 Discuss and Write Up

Write up the process, findings, and reflections in a detailed report. This should encompass the initial problem, the theoretical background, and the iterative development of the final design framework.

Ensure that you discuss the implications of the final design framework for both theory and practice and include suggestions for future research.

Variations:

The proposed model is intended to describe what is basic to EDBR, however some of the Cambridge EDBR studies we looked at offer variations and extra features.

Conjecture Mapping:

Conjecture mapping is a structured way to develop Design Frameworks: it involves formulating high-level conjectures based on theory and evidence, linking these to specific design elements to be embodied in the educational environment, and detailing the mediating processes that the design elements are expected to trigger. The approach culminates in the definition of measurable outcomes to evaluate the intervention's effectiveness. (For more details, see Example 4)

Parallel Testing in EDBR:

The basic model assumes integrating design conjectures into a comprehensive design framework and testing this, which requires waiting for the findings of one iteration before beginning another. Parallel testing, by contrast, involves the simultaneous investigation of multiple design conjectures. Each is tested separately and in parallel within different cases. This multi-faceted exploration can potentially lead to more rapid innovation. (For more details, see Example 2 & 8).

Adding a Control Group Study in the Final Iteration of EDBR

In the final iteration of EDBR, conducting an intervention study with a control group can be a way of more rigorously evaluating the impact of the final design. (For more details, see Example 10).

Some issues with EDBR:

There is the risk of researcher bias, particularly when interventions are implemented by the researchers themselves or their close collaborators. To mitigate this researchers need to articulate conjectures clearly before implementation so that it is clear what counts as failure or success and then they need to take the failures they encounter as seriously as the successes allowing the voice of the evidence to challenge and develop their thinking. It is usually a good idea to incorporate multiple perspectives from a range of stakeholders at each stage of the EDBR process.

EDBR is tailored to address local educational needs but the aim is to produce theories of how to teach and learn that have wider relevance. As far as possible it is a good idea to replicate EDBR across various student groups and cultural contexts although this might often be a feature of the 'further research' section of the concluding chapter of a PhD.

EDBR operates in messy real-world settings where it is hard to distinguish which factors influence outcomes and whether design conjectures are really confirmed or disconfirmed. EDBR addresses this by employing iterative cycles that facilitate the comparison of different intervention iterations. For a more rigorous measurement of the interventions' effectiveness, the EDBR results could be built upon with a subsequent control study.

Select Bibliography:

1. Cobb, P., Confrey, J., diSessa, A., Lehrer, R., & Schauble, L. (2003). Design Experiments in Educational Research. Educational Researcher, 32(1), 9–13. https://doi.org/10.3102/0013189X032001009

- This article introduces the methodology of design experiments in educational research. The authors discuss the theoretical underpinnings of design experiments and provide guidelines for conducting such research. The article is significant for its foundational perspective on merging empirical educational research with practical design.

2. Hoadley, C. M. (2004). Methodological Alignment in Design-Based Research. Educational Psychologist, 39(4), 203–212. https://www.tandfonline.com/doi/abs/10.1207/s15326985ep3904_2

- Hoadley critiques empirical research rigour and champions DBR for better educational outcomes. It examines the role of DBR in ensuring that educational research methods align with what they aim to test. Hoadley argues for a balanced approach to research rigour and details how EDBR adapts over time for effective application in real classrooms. The work is instructive for researchers seeking to connect educational theory with practice.

3. Sandoval, W. A. (2004). Developing Learning Theory by Refining Conjectures Embodied in Educational Designs. Educational Psychologist, 39(4), 213–223. https://www.tandfonline.com/doi/abs/10.1207/s15326985ep3904_3

- This article discusses how 'embodied conjectures' in learning environments are refined through empirical study, enhancing instructional design and learning theory. Sandoval provides a case study to illustrate this process, highlighting the importance of iterative design and evaluation in educational research. This example is used to suggest some general features of embodied conjectures and to raise methodological issues for refining them.

4. Stylianides, G. J., & Stylianides, A. J. (2014). The role of instructional engineering in reducing the uncertainties of ambitious teaching. Cognition and Instruction, 32(4), 374-415. https://www.jstor.org/stable/43941151

- The authors discuss a framework for instructional engineering to aid ambitious teaching, which requires teachers to respond dynamically to students. They illustrate its use in teaching mathematical proof, showing how it helps teachers manage classroom uncertainties and achieve complex educational goals.

5. The Design-Based Research Collective. (2003). Design-Based Research: An Emerging Paradigm for Educational Inquiry. Educational Researcher, 32(1), 5–8. https://journals.sagepub.com/doi/10.3102/0013189X032001005

- This article advocates for design-based research as a key method for integrating educational theory and practice. It highlights how this approach can foster learning, enhance knowledge creation, and inform educational reform by examining the efficacy of innovations in real-world settings. This paper is foundational for those new to DBR and establishes a context for its role in educational research.

6. Wang, F., & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environments. Educational Technology Research and Development, 53(4), 5–23. https://link.springer.com/article/10.1007/BF02504682

- Wang and Hannafin review the past decade's use of design-based research (DBR) in the creation of technology-enhanced learning environments (TELEs). They outline the defining characteristics of DBR, its significance in TELE development, and principles for its implementation. The paper also contemplates challenges for DBR, making it a relevant read for researchers and designers working with educational technology.

7. Bakker, A. (2018). Design Research in Education (1st ed.). United Kingdom: Routledge. https://www.taylorfrancis.com/books/edit/10.4324/9780203701010/design-research-education-arthur-bakker

- This book is an introduction to design research, a method for developing and studying innovative educational practices. Bakker explains how this approach is proactive and flexible, tailored to crafting and evaluating new learning experiences that extend beyond current educational frameworks. The work highlights design research's distinctiveness and its function in guiding educational improvements across various research domains.

Appendix: A List of Reviewed Theses

1	Dialogic education, historical thinking and epistemic beliefs: a design-based research study of teaching in Taiwanese classrooms	Chih-Ching Chang
2	Using Mobile Phones to Enhance Small Group Dialogic Learning: A Design-Based Approach to Educational Innovation in Rural East Africa	Kevin Christopher Martin
3	Developing dialogic mathematics teaching with tablet technology in Chinese primary school classrooms: A design-based research approach to teacher professional development	Liu, Qian (Dora)
4	Developing Teachers' Contingent Responsiveness in Dialogic Science Teaching via Mixed-reality Simulations: A Design-based Study	Cao, Yu (Lydia)
5	Implementing dialogic education approaches in Chinese science classrooms: A design-based research	Yun, Long
6	The Playground of Ideas: A design-based research investigation into dialogic thinking with six- and seven-year-old children in England	Kerslake, Laura
7	The design, development and evaluation of an augmented reality intervention to support collaborative creative thinking at lower secondary school.	Gomez, Aitor
8	Designing and Evaluating a Virtual English Enrichment Course for Improving Chinese Learners' Communicative Competence in English	Du, Min
9	Designs and affordances for dialogue in Google Classroom: a design-based research study	Igglesden, Tristan
10	Can Retrieval Practice of The Testing Effect Increase Self-efficacy in Tests and Reduce Test Anxiety, in 10- to 11-Year-olds?	Barsham, Helen
11	Dialogic teaching for students with conditions within the autism spectrum	Trigo Clapes, Ana
12	Improving Secondary Students' Revision of Physics Concepts through Computer-mediated Peer Discussion and Prescriptive Tutoring	Benson Mun Hong Soong
13	Humanisation of Online Learning: Experiences That Matter.	Chmilewsky, Alona
14	Investigating the relationship between dialogic interaction and written argumentation in A Level History	Diana Marie Hilliard
15	Investigating children's perspective taking and normative frames of social understanding: A critical design ethnographic study of teacher-led dialogue around stories in early years' classrooms	Froehlig, Courtney