A Design-Based Research (DBR) Framework to Guide Curriculum Design

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This guide briefly explores

Why use Design Based Research (DBR) to guide curriculum design?

DBR is described as an authentic and ethically-based approach to curriculum design, and a pragmatic research methodology for dealing with real world learning contexts (Amiel & Reeves, 2008; Wang & Hannafin, 2005).

Simply put it is a framework for curriculum design that purposefully uses research to achieve learning outcomes.

Using DBR ensures curriculum design is underpinned with scholarly reflection and principles, often referred to as:

- the Scholarship Of Teaching and Learning (SOTL),
- or the Scholarship of Technology Enhanced learning (SOTEL) when using technology to enhance teaching and learning.

Why use DBR?

- DBR treats curriculum design as what Laurillard terms a 'design science' (Laurillard, 2001, 2012) rather than simply reusing simple course design templates or a rule of thumb approach.

- Research outputs of a curriculum design project are easily put together using DBR.

This guide attempts to provide a framework for implementing DBR in curriculum design to ensure scholarly reflections and principles occur.

What is DBR?

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Key Features in DBR include:

- DBR starts with identifying and addressing a **specific problem or a design goal**. It "bridges the demand for rigorous research with the development of relevant solutions to educational problems" (Kopcha et al., 2015, p. i).

- DBR is usually a **collaborative process** that involves a democratic team approach consisting of educational researchers, practitioners, developers, and other key stakeholders (that could include industry representatives, and students) working together on a pedagogical problem and design solution.

- Design based research provides a **structured, four-phase iterative framework** (McKenney & Reeves, 2019) for designing authentic learning environments for education that go beyond simply transferring practice from one technology to another (Reeves & Lin, 2020).

- The overall goal of DBR curriculum design projects are the development of **transferable design principles** that can be applied to other curriculum contexts exploring similar pedagogical goals or issues.

Each stage of DBR can be informed by a SOTL or SOTEL research output such as a literature review, a conference paper, or a journal article, as shown in figure 1. For example, Kopcha, Schmidt, and McKenney (2015) define three types of educational design research (EDR) studies:

1. Analysis and exploration studies that focus on understanding educational problems through analysis of the literature, stakeholders, and context.
2. Design and construction studies that focus on presenting design frameworks along with the theoretical and empirical grounding that gives them shape.
3. Evaluation and reflection studies that describe the practical and scientific implications that result from formative and/or summative evaluations of designed interventions (Kopcha et al., 2015, p. i).

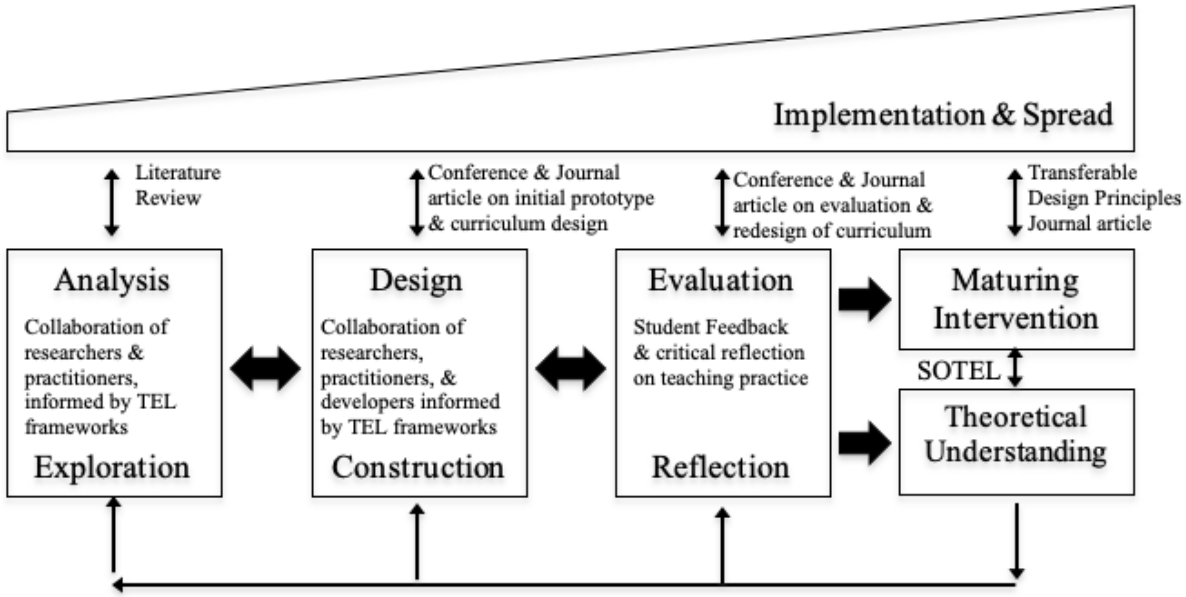

Figure 1: The four phases of Design-Based Research adapted from McKenney and Reeves (2019)

The four phases of a curriculum design project as illustrated in Figure 1 are:

Phase 1: Analysis and exploration - Identification of the curriculum design problem – how to design an authentic student-centred project that is authentically scaffolded across a curriculum and the critical issues surrounding the specific learning environments. Followed by the exploration of supporting literature to identify initial design principles to address these issues.

Phase 2: Design and construction – Prototyping of the collaborative curriculum design informed by the identified design principles.

Phase 3: Evaluation and reflection - Evaluation of the prototype curriculum and subsequent collaborative curriculum redesign through user feedback (students and project team peers), and refinement of the design principles.

(Phase 2-3 Loop: Iterative redesign and re-evaluation of the collaborative curriculum design).

Phase 4: Theory building - Development of transferable design principles and dissemination of findings for application to other higher education learning contexts.

Key steps in applying DBR to curriculum design:

1. Identify what is the problem or learning design intervention?
2. Craft a research question/s
3. What design principles can inform the design of the curriculum?
    - Use a DBR methodology
    - Create a collaborative curriculum design team
    - Identify the foundational learning theories that match the graduate outcomes
    - Design learning activities and assessments that scaffold the Pedagogy-Andragogy-Heutagogy (PAH) continuum
    - Develop a learner-centric ecology of resources
    - Build iterative evaluation and redesign into the on-going curriculum design process

Breaking down the four phases of DBR:

Analysis

- What is the problem or learning goal you are addressing/exploring?
    - How can the graduate outcomes be achieved?
    - Are there threshold concepts that students struggle with? (Land et al., 2005)
- What learning theories are relevant to the context?
- Where is the course learning focus located on the Pedagogy-Andragogy-Heutagogy (PAH) continuum? (Luckin et al., 2010):
    - Teacher-centric (P), student-centred (A), or student-determined learning (H)?
    - Competency (P) or capability building (H)?
    - Note the notion of a 'continuum' implies that the course design can move between these three pedagogical foci as appropriate
- Formulate research questions for SOTL/SOTEL

Exploration

- What has been done before? – literature review
- What are possible solutions to the learning problem
- What initial design principles can be identified from the literature?
- What are the characteristics of your learners?
    - Digital literacies
        - JISC digital capabilities (JISC, 2017)
        - VandR Mapping (OCLC, 2016; White & Le Cornu, 2011)
    - Demographics and socio-cultural characteristics
        - Pre-Survey of learners
- What are the significant limitations of the context?
    - Large or small classes
    - Technology access?

    - Mode of interaction – F2F, online, dual delivery?
    - Accreditation constraints?

Design

- Create a Collaborative curriculum design team with educational researchers, practitioners, developers, industry and students – utilise a reflective team space/hub to facilitate reflective process
- Focus upon facilitating authentic learning and building learning community rather than content delivery
- How will the curriculum scaffold the PAH continuum?
- What is an appropriate Ecology of Resources (EoR) for this context? (Luckin, 2008)
    - What tools/platforms are currently used in the industry/profession?
    - How does the EoR map to core graduate outcomes?
    - Does the EoR support learner personalisation and self-regulated learning?
    - Balance synchronous and asynchronous interaction
    - How might student ePortfolios and Collaboration be integrated into the curriculum?
    - What scaffolding is required for students to effectively use the EoR?
    - What are the BYOD (Bring Your Own Device) and infrastructure requirements?
- What learning design frameworks are relevant?
    - What role do the learners play in the learning design/activities/assessments?
- Build in student digital literacies and feedback
- Build in authentic activities and assessment and make the marking criteria explicit
- Provide examples of best practice for the learners
- Build in explicit formative feedback
- Build in student negotiation and evaluation

Prototyping/Construction

- Apply learning theory through choosing appropriate learning design frameworks to guide the design of staged and scaffolded activities and assessment
- Include both timely formative and summative assessment
- Apply your chosen EoR to the activities and assessment to facilitate authentic learning experiences
- Build in learner-generated contexts (Luckin et al., 2010) and learner-generated content (Blaschke & Hase, 2019)
- Make the mapping between the graduate outcomes, EoR, and activities and assessments explicit

Evaluation

- Student and peer feedback on the impact of the prototype learning design
    - Follow Ethics consent processes
    - Define data, collection strategies, and analysis strategies
    - Go beyond exploring student engagement and satisfaction - how will you measure/evaluate the impact upon student learning, or a specific measure?

Reflective Redesign

- Address critical feedback through refinement of design principles and redesign of elements of the curriculum (activities and assessments)

Theoretical Understanding

- Refinement of the design principles
- Development and publication of design framework/s

An example Collaborative curriculum design Team

Collaborative curriculum design teams bring together the expertise from practitioners, educational researchers, and technology specialists. Table 1 shows the make-up of one example curriculum design team.

Table 1: Example curriculum design team details

Team Member	*Department/Course*	*Role in curriculum design project*
Academic Lecturer1	Biomechanics 3rd year	Project lead and Biomechanics curriculum design
Academic Lecturer2	Biosystems 3rd year	Biosystems curriculum design
Academic Lecturer3	Circuits and Systems 3rd year	Circuits and systems curriculum design
Academic Lecturer4	Programming 2nd year	Programming curriculum design
Educational Researcher	MCSHE	Educational Technology design
Graduate student Designers	UoM	Bionic Limb prototype development

An example DBR curriculum design timeline and milestones

It can be useful to Map a timeframe and output goals of a course design/redesign project to the DBR phases – this example is a two-year project, but the timeline need not be so extended in your case.

Table 2: Example curriculum design project timeline and milestones

Project Milestones	**Project Timeline**	**DBR Stage**
Initial Project Proposal	July 2020	Analysis
Scoping of project	September 2020	Analysis & Exploration
Fortnightly brainstorm/planning meetings of design team	September-December 2020	Analysis & Exploration
Collaborative curriculum design	September-October 2020	Prototyping collaborative curriculum design
Recruitment of student developer for Bionic Limb prototype	October 2020	Prototype Bionic Limb Design
Ethics consent for student participation and evaluation of project in 2021	October-December 2020	Prep for implementation & evaluation
Conference presentation and journal article on project analysis and prototype design stages	December 2020 – February 2021	Report on prototype bionic limb and initial collaborative curriculum design principles
Implementation in 2nd year programming course	Semester 1 2021	Prototype collaborative curriculum design implementation
Implementation in Mechanics course	2021	Prototype collaborative curriculum design implementation
Implementation in Circuits & Systems course	2021	Prototype collaborative curriculum design implementation

Implementation in Biosystems course	2021	Prototype collaborative curriculum design implementation
Stake-holder evaluation	Second Semester 2021	Evaluation of prototype collaborative curriculum design
Conference presentation and journal article on project evaluation and redesign stages	December 2021 – February 2022	Report on impact on student learning of collaborative curriculum design
Redesign of curriculum project and re-evaluation	Semester 1& 2, 2022	Redesign of collaborative curriculum design and refinement of design principles
Dissemination of project outcomes via journal article on transferable design principles	End of Second Semester 2022	Dissemination of refined collaborative curriculum design principles

Brief summary of learning theories and design frameworks

Learning theories attempt to explain key concepts around how we learn, each with an emphasis upon a particular aspect of learning, and have been the result of a timeline of research into teaching and learning. You can find out more about these learning theories and frameworks summarised here at **https://teacherofsci.com/learning-theories-in-education/.**

SUMMARY OF LEARNING THEORIES

Constructivism - learning is built upon prior knowledge and extended
Social constructivism - learning is essentially a social collaborative process extended by more experienced peers
Constructionism - knowledge is essentially relative and constructed
Behaviorism - rote learning emphasising memory recall, linking stimulus & response
Connectivism - emphasises network creation rather than content delivery
Cognitivism - learning is a process of creating neural connections
Cognitive Load Theory - learning is designed to minimise cognitive overload
Situated Learning - an apprenticeship model of learning
Experiential Learning – Kolb – knowledge is constructed through experience
Humanist – Rogers – Teacher as facilitator of learning
Community of Practice – a peer support model that aims to draw learners' from peripheral to active participation in a shared domain of interest
Community of Inquiry – focuses upon creating presence in three dimensions: social, cognitive, teacher
Socio-Cultural theory -

While learning theories attempt to explain key concepts around how we learn, learning design frameworks attempt to provide practical guidelines for applying learning theory/s to the design of learning environments.

SUMMARY OF LEARNING DESIGN FRAMEWORKS

Rhizomatic learning - a decentralised explorative model of learning
Conversational framework (ABC) - a Socratic model of questioning & answering between lecturer and student
SAMR framework (A continuum from Substitution, Augmentation, Modification, through to Redefinition)
Pedagogy 2.0 - teaching and learning that is user-centric, collaborative, and makes use of social media
Constructive Alignment - Bigg's concept of aligning learning activities, goals, and assessment appropriately
Problem Based Learning - based around real world problem solving scenarios
Design Thinking - a cycle of exploration, design, prototyping, evaluation
Authentic Learning - theory and practice are aligned through real world scenarios
Learner Generated Contexts - learning is designed around student discovery
Pedagogy-Andragogy-Heutagogy Continuum – scaffolding teacher-centric pedagogy towards learner-centric determination

Blooms Taxonomy - Remember, Understand, Apply, Analyse, Evaluate, Create

Creating a learner-centric ecology of resources – deciding which technologies to use

An ecology is a balanced ecosystem made up of many interdependent elements. There is no one single educational technology tool that meets every learning or learner need. Learner-centric ecologies of resources that support learning activities and assessments should be authentic (using real world tools), and support learner personalisation, learner-generated content, and learner-generated contexts, and elements of learner-negotiation.

Luckin defines a learner-centric ecology of resources and how it supports learning: "*Ecology of Resources: a set of inter-related resource elements, including people and objects, the interactions between which provide a particular context*" (Luckin, 2008, p. 452).

Blaschke and Hase (2019) explore designing an authentic learner-centric Ecology of Resources, using digital media networks (Blaschke & Hase, 2019).

Use this PADLET template to construct your own Ecology of Resources.

Creating a visual hub and spoke diagram to connect an EoR to core learning outcomes is useful – as illustrated in Figure 2.

The EoR is defined by the core graduate attributes and learning outcomes, and real-world technologies mapped to learning theories and frameworks that support these. These elements may include, for example (Figure 2):
(1) a community-driven hub and discussion forum (connectivism)
(2) communication channels (social constructivism)
(3) opportunities for sharing practice (rhizomatic learning)
(4) collaboration across the wider network (brokering communities of practice)
(5) a repository for student work, such as an ePortfolio (learner-generated content)
(6) building a BYOD infrastructure strategy (enabling learner-generated contexts)

Figure 2: An ecology of resources model to support a learner-centric curriculum.

Explore more – Example Case Studies:

Designing online clinical practice workshops (Kartoğlu et al., 2020)
https://doi.org/10.1007/s11528-020-00509-0

Designing virtual reality learning environments (Lähtevänoja et al., 2020)
https://doi.org/10.4018/978-1-7998-5043-4.ch005

Design for creative pedagogies (Cochrane & Munn, 2020)
https://doi.org/10.24135/pjtel.v2i2.58

A design-based research approach for developing data-focussed business curricula (Miah et al., 2020)
https://doi.org/10.1007/s10639-019-09981-5

Design principles for student-determined learning (Narayan et al., 2019)
https://doi.org/10.14742/ajet.3941

Redesigning an undergraduate reading methods course using DBR (Isidro, 2019)
https://doi.org/10.1080/14623943.2018.1562438

Designing mobile VR learning environments (Cochrane et al., 2017)
https://doi.org/10.14742/ajet.3613

Designing creative learning environments (Cochrane & Antonczak, 2015)
http://www.mifav.uniroma2.it/inevent/events/idea2010/doc/24_8.pdf

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