EDeR

Educational Design Research

Volume 4 | Issue 2 | 2020 | Article 30

Contribution Academic Article

Title **Outline of a holistic design-based research model for higher education**

Author **Gabi Reinmann**
University of Hamburg
Germany

Abstract Design-Based Research (DBR) is not yet an established methodological framework in the context of higher education; nevertheless, it is increasingly used in projects in order to develop and explore new teaching/learning methods or scenarios and being taught in degree programs. The article presents the outline of a holistic DBR model and unfolds its construction in several steps based on practical experiences in applying DBR by means of existing models. The DBR cycle is visualized as a circle with five semantic fields; the choose modelling especially considers different forms of part-whole relationships in the DBR process. The model is also used to reflect on methodological issues in DBR and to consider the role of design objects.

Keywords higher Education
holistic model
part-whole relationships
iteration type

DOI dx.doi.org/10.15460/eder.4.2.1554

Citation Reinmann, G. (2020). Outline of a holistic design-based research model for higher education. *EDeR – Educational Design Research,* 4(2), 1-16.
http:// dx.doi.org/10.15460/eder.4.2.1554

Outline of a holistic design-based research model for higher education

Gabi Reinmann

1.0 Reasons for the model

In teaching as well as in research practice, I repeatedly encounter particular challenges in Design-Based Research (DBR) in the context of higher education generating controversies that do not question DBR as a methodological framework in principle but that express a certain dissatisfaction with existing ambiguities. In particular, the scientific[1] nature of design activities in the research process and the generalizability of results regularly raise concerns (e.g., Bakker, 2018, pp. 39 ff.). This article considers three challenging aspects of DBR that are related to these fundamental issues yet have specific emphases. (a) The iterative-cyclical nature of DBR is considered one of the most important common features of existing models while causing recurrent problems both in practice and in theoretical consideration. The definition of phases and their representation imply an (unintentional) linearity, the proposal of and examples for cycle subtypes cause confusion (contrary to the intended clarification),[2] and the question ultimately remains open as to what exactly the iterative-cyclical nature of DBR is. (b) There are usually no restrictions in the use of methods in the context of DBR, which is quite consensual. However, when the methodological side of DBR is highlighted, empirical methods are the focus of attention, while those for theoretical work and design are less addressed. Moreover, in the application of empirical methods within DBR, there is often uncertainty about which methodological demands are to be met and to what extent the purpose of application can and may influence the use of selected methods. (c) It often turns out to be a difficult task to determine what the actual design object in a DBR project and the nature of the "intervention"[3] that one wants to develop and research are. Researchers rarely make explicit and reflect upon how they deal with the fact that complex interventions may have several components that are interwoven, nested, or even treated separately.

This paper describes a DBR model that seeks to address these challenges with both novices (in teaching practice) and experts (in research practice) in mind. The labeling of the model as holistic primarily aims to highlight the part–whole relationship (Nelson & Stolterman, 2014, p. 93) relevant to DBR; throughout the text, various rationales for this term are given. My reflections on the elaboration of the model rely on existing DBR literature,[4] on my own experiences from teaching DBR in university, and on practical research experiences in DBR projects.

Preliminarily, I would like the holistic DBR model to be understood as one for research and teaching in higher education. It is special to and

[1] In the sense of *wissenschaftlich* and not restricted to natural sciences.

[2] McKenney and Reeves, for example, used the terms micro-cycle, meso-cycle, macro-cycle in the first edition of "Conducting Educational Design Research" (McKenney & Reeves, 2012, p. 78); in the current edition, they refrain from doing so and only refer to "sub-cycles" (McKenney & Reeves, 2019, p. 84).

[3] The term is to be understood as a placeholder for all possible "measures" in the context of higher education practice; in the sense of an "intervention in a practice," the term intervention is, in my estimation, apt since didactic action always intervenes in a practice of action or establishes a (new) one.

[4] The papers, a substantial part of which are referred and in which I have dealt with DBR in a literature-based way, have been compiled in a reader accessible online (Reinmann, 2019a).

relevant for DBR in German higher education that practitioners are researchers themselves (Reinmann, 2019b). As with any other DBR model, the present model outline is focused on the dual goals of producing interventions that are immediately useful in practice *and* generating theoretical insights that appropriately extend beyond the singular case under study. The work with and on theories, the use of empirical methods, and the design also form the methodological triad in this DBR model, which I set as a premise.

In the following sections, I unfold the model in five steps. In a first step, I determine five *semantic fields* that delineate the scope of meaning of a DBR cycle. I deliberately do not refer to these as phases or processes because the primary concern here is with the meanings of research action that shape the nature of DBR as a whole. In a second step, building on this, I define five *fields of action* into which foci of activity can be projected. The term *field of action* should emphasize that here we are dealing with concrete activities that can only ever be a part of the whole because every action requires a certain focus of attention. In a third step, I propose *playing fields*: this metaphorically designated bridge between the focus of action (as a part) and the core of essence (as a whole) of DBR is suitable for illuminating the scope of action that opens up—especially for experts. These three steps form the line of reasoning for the description and justification of the holistic DBR model are outlined here. In a fourth step, I address the *question of methods* in DBR and examine the extent to which the model is suited to constructively address typical difficulties in dealing with methods in DBR. In a fifth and final step, I address the role of *design objects in DBR* and again explore the question of what added value the holistic model can have for this. The paper ends with a summary conclusion.

2.0 Semantic fields of the model

DBR has several different graphical illustrations, and it is beyond the scope of this paper to list them all. Widely used is the representation of the generic model by McKenney and Reeves (2012, p. 77); a lesser known but an interesting variant of it is the process model by Easterday, Rees Lewis, and Gerber (2017, p. 138). Both visualizations show phases and draw attention to their iterative-cyclical relationship by using arrows. Especially in the German-speaking world, Euler's model (2014, p. 20) has a certain degree of recognition, and its graphical implementation connects phases to a circle (or a large circle and a smaller circle embedded in it). Other authors, such as Bakker (2018), do not include a visualization of their model assumptions. Figure 1 visualizes the DBR cycle as I envision it in a holistic model; a cycle generally refers to a sequence of elements or processes connected in a circle. The circular representation is therefore intrinsic to the term. Neither an absolute beginning nor an absolute end can be identified here; theoretically, one can enter a DBR cycle at any point, and it can be repeated any number of times (*iteration type I*). The terms *goal setting*, *conception*, *development*, *testing*, and *analysis*, arranged as a circle, are similar to the process and phase terms of the models mentioned above

(McKenney, 2012; Easterday et al., 2017; Euler, 2014); thus, at first glance, it is primarily a variation on the familiar.

The difference is that I understand goal setting, conception, development, testing, and analysis as *semantic fields* that define the scope of meaning of a DBR cycle. A semantic field means a group of related concepts; in the context of DBR, these refer to research activities. All the meanings, grouped here into five semantic fields, must *coincide to* constitute the essence of DBR.

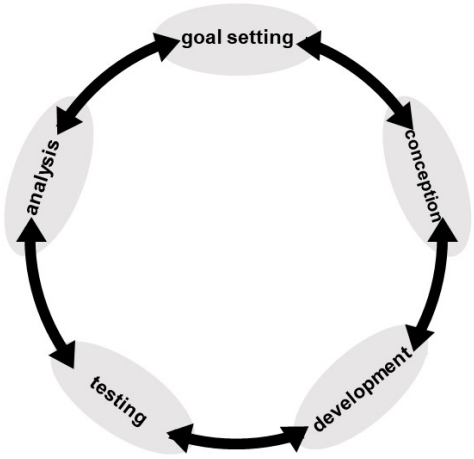

Fig. 1: Semantic fields of the holistic DBR model.

If one focuses solely on testing and analyzing an intervention or on conceptualizing it based on a goal analysis—to cite just two examples—one is *not* practicing DBR. The following paraphrases explain the semantic fields of the holistic DBR model in slightly more detail.

- *Goal setting*: identifying desired goal states, describing challenges, defining problems, determining targeted interventions, describing desired outcomes, stating the purpose of planned actions, explaining values, etc.
- *Conception*: mentally anticipating target states, mentally modeling desired outcomes, formulating theoretical assumptions, creating models for potential designs of intervention, producing sketches, dummies, mockups, and the like, and so on.
- *Development*: concretizing what has been concepted, materializing models, developing working pilot designs, translating theoretical assumptions into designs, building (several) prototypes of an intervention, and so on.
- *Testing*: turning what has been developed into (initial) action practice, updating prototypes, trying out constructions in practice, testing the functionality, practicability, effectiveness of interventions, and so on.
- *Analysis*: examining data and artifacts, systematically exploring experiences and observations from trials or tests, validating assumptions, making theoretical references, reviewing objectives and normative ideas, and so on.

Goal setting, conception, development, testing, and analysis as semantic fields describe the DBR cycle as a whole in its *structure* (versus processuality), which lies behind the core concern of DBR. This consists in obtaining both a practicable and "mature" intervention (practical goal) and knowledge about the possible applications and modes of action of this intervention that go beyond the individual case (theoretical goal). If all five semantic fields as a structure in a DBR cycle are of fundamental importance, goal setting, conception, development, testing, and

analysis should also be present in the researcher's mind. I assume that the wholeness of the structure is operative in the *background consciousness*[5] of researchers who, as DBR experts, have internalized the core concern of this methodological framework. I deem this important because it is not individual parts of DBR that particularly stand out from other research approaches but only their combination in the outlined shape of a whole cycle; there they mentally have a certain *simultaneity*, which in turn excludes thinking in phases.

[5] Here I am largely guided by the notions of background and focal consciousness as elaborated by Neuweg (2020, p. 182 ff.), following Polanyi in the context of tacit knowledge.

3.0 Fields of action of the model

It goes without saying that researchers in DBR cannot engage in goal setting, conception, development, testing, and analysis in parallel at any given time. In concrete action, researchers set a focus in the here and now, directing their attention to selected parts of the whole. One could also say that the *focal consciousness of* researchers is probably on *one* DBR field of action at a certain point in time. Figure 2 extends the first visualization and tries to explain that it is by no means static, even in the mode of focusing what constitutes a field of action and to what extent; fields of action are themselves cyclic-iterative in a special way.

The image shows a segmentation of the circle. Each segment is formed or limited by two semantic fields. In each circle segment, another small circle symbolizes that researchers in DBR move back and forth between two semantic fields in their concrete actions: i.e., between goal setting and conception, conception and development, development and testing, testing and analysis, and analysis and goal setting. This form of iteration as a rapid change between two foci can be called oscillation (*iteration type II*). The following sections describe this in more detail.

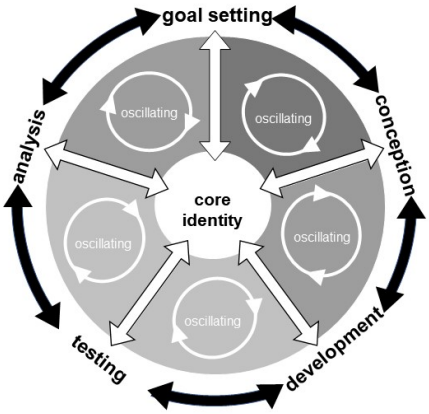

Fig. 2: Fields of action in the holistic DBR model

- *Goal setting* ←→ *conception*: In the formulation of goals, initial concepts or design sketches may already be guiding; at the same time, goals and values direct the process of conceptualizing. Goal definitions may turn out to be unrealizable or poorly realizable in the process of conceptualizing; at the same time, the process may generate new goals and change normative ideas. Researchers in DBR constantly mentally shift between goal setting and conception.
- *Conception* ←→ *Development*: Every development is based on mental modeling in the form of a draft concept, and every conception already anticipates possible developments in a simulative

manner. In the process of developing, conceptions may turn out to be inappropriate and require new sketches. Conceptualizing and developing activities are sometimes hard to separate in their close and dynamic interrelationship.

- *Development* ←→ *Testing*: Developments must prove themselves, which makes testing indispensable; what these look like is determined by developments and their own purpose. In the process of testing, developments can be adapted, or new ones become necessary; for this purpose, testing can be stopped and restarted. In smaller cycles, development and testing can follow each other so closely that they form a unit.
- *Testing* ←→ *Analysis*: Testing produces results that are subject to analyses; the subject and goal of analyses depend on the setting of the testing. Analysis activities change in the process of pilot implementations; at the same time, ongoing analysis results sometimes lead to changed pilot implementations. Testing and analyzing converge primarily in formative intent, even if they are analytically separated.
- *Analysis* ←→ *goal setting*: How one interprets the results of analyses from trials is essentially determined by set goals and values; at the same time, goals and values for new conceptions and developments may change as functions of analyses. Goals may be the result of analyzing a baseline situation, and dealing with the baseline situation is simultaneously influenced by goals in advance. Necessarily, researchers in DBR constantly relate goals and analyses to each other since what researchers want to recognize via analysis is inextricably intertwined with evaluative processes. These do in turn need a reference.

If researchers are not following the deductive logic that is often implied by phases (according to the scheme: goals result from analysis, from which conceptions emerge, which results in developments, and so on), another reference is needed for upcoming decisions. In the holistic DBR model, this reference is the *core identity.* I have chosen this name because I think it accurately expresses the function that is required here, namely to provide a reference point for decisions and actions so that they acquire a certain DBR-internal consistency. The core identity is thus—metaphorically speaking—compass *and* parenthesis: on the one hand, no DBR process begins without a core idea of the whole; on the other hand, the *identity of* an entire DBR project is constituted only during the various decisions and results. In DBR, the core identity is thus both a prerequisite and a result.

4.0 Playing fields of the model

The widespread DBR models, as briefly mentioned at the beginning, usually incorporate interrelationships between all phases or processes in their graphical representations. This is an attempt to fulfill the claim often formulated that iterations in DBR should be possible between all processes, which is, however, extremely difficult to grasp and realize

in combination with the logic of phases. In comparison, the circular visualization of the holistic DBR model initially (theoretically) reduces the iteration possibilities, namely to the iteration of the entire cycle (*iteration type I*) and to the iteration as oscillating between two action foci (*iteration type II*). My observation from teaching is that these iteration types can still be well understood by novices. In contrast, I assume that experts with DBR experience perceive further possibilities for action as a result of their metacognitive knowledge base (cf. Carlson, Rees Lewis, Maliakal, Gerber & Easterday, 2020, p. 3 f.). I tentatively call them "playing fields" to express that they are scopes of action or of free play recognized and used by DBR experts but sometimes difficult to understand and to access by novices. Playing fields emerge when grouping three semantic fields, whereby each semantic field that can be multiply used in different combinations undergoing variation in meaning depended on the combination context.[6] Playing fields are also cyclic-iterative, which means that occurring activities in these fields are also related to each other and influence each other (*iteration type III*). The following sketches of the five playing fields are intended to illustrate this:

[6] Herzberg (2020) also formulates in a slightly different context such a basic principle of recombination in the context of DBR from the perspective of the use of methods.

- Goal setting ←→ conception ←→ development: In the combination of goal setting, conception, and development, *creative conceiving of* interventions is the central point, "nourished" by goal and norm reflections and discussions on the one hand and initial materializations and prototype formations on the other. Here, goal setting and development serve to model the envisaged intervention.
- Conception ←→ development ←→ testing: In the combination conception–development–testing, *concrete developing of* interventions forms the fixed point and draws on concept sketches and testing in order to move forward. Testing is done only as far as the development work needs it; adjustments in conceptions are made to the extent that seems acutely necessary.
- Development ←→ testing ←→ analysis: In the combination of development–testing–analysis, *practical testing of* interventions is the center of what happens. It relies on the ability to integrate developmental work into the context of trying things out where necessary to move forward productively, and it takes an analyzing approach to what works or is brought about.
- Testing ←→ analysis ←→ goal setting: In the combination of testing–analysis–goal setting, *rational analyzing* becomes the pivotal point. Results from testing an intervention are evaluated; compared with theory, goals, and normative ideas; and conclusions are derived. What is important here are well-founded links between what can be recognized factually and what was expected.
- Analysis ←→ goal setting ←→ conception: In the combination of analysis–goal setting–conception, one concentrates on *normative working with goals* and on the understanding of problems and desired states. Analyses from initial situations or tests provide evidence for the discussion of goals and values; in drafts or concept changes, conclusions or new ideas are revealed.

Graphically, these combinations cannot be meaningfully integrated into the previous form of visualization of the holistic DBR model. Figure 3 therefore shows the five playing fields separately. This representation also visualizes structures (as already in Figures 1 and 2) and therefore does not imply a mandatory order. Compared to the fields of action, playing fields are also part of the DBR whole, but they form larger or more complex units and as such—for a certain period in the research process—can themselves form a whole. They require a certain *distributed* attention from the researcher, while focal awareness must be directed to more complex (new) units.

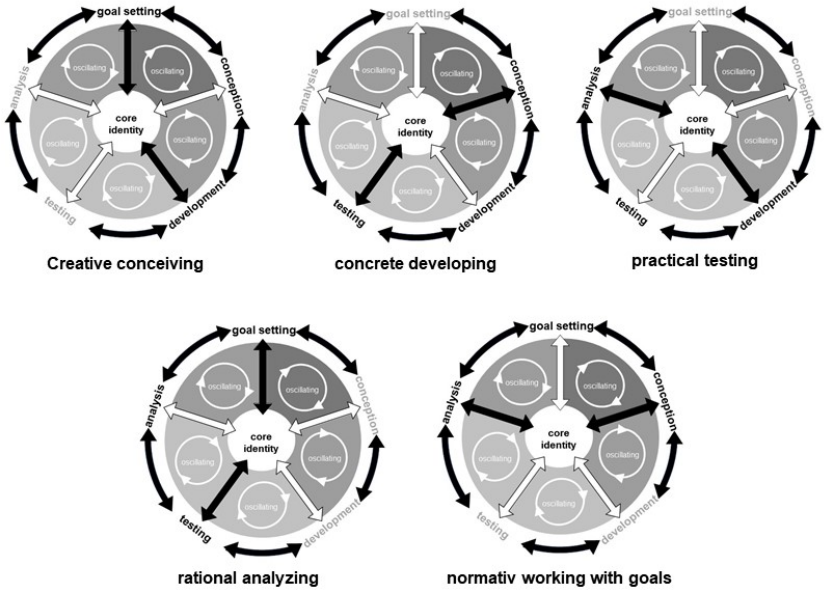

Fig. 3: Playing fields in the holistic DBR model

5.0 The model and the question of methods

DBR is neither a method nor a methodology but, as Bakker (2018, p. 7) puts it, "something in between"—a methodological framework. Thus, highly diverse scientific methods for empirical, theoretical, and design work, understood as planned or rule-based approaches that meet defined criteria, can be used within DBR. However, the concept of methods in the context of DBR is highly associated with *empirical methods* for collecting and analyzing data. There are different classification systems for these, which in essence show sufficient agreement to be able to determine methodological standards—for example, observational, survey, or other data may be used for methods of collection as well as for their numerical, visual or verbal analysis. No one will probably deny that theoretical work is also methodologically guided; nevertheless, it is much more difficult to define and categorize *theoretical methods* as they tend to be even more culturally anchored than empirical methods. They entail more different terms, are less systematized in consensus, and often remain implicit. In the scientific literature on DBR, it is always emphasized that the theoretical connectivity of the development of interventions as well as a theoretical yield from their testing and analysis is crucial for the scientific character of DBR. However,

[6]Archer (1979) etwa sieht im Modellieren/Herstellen („modeling") neben mathematischen Sprachen („notation") und natürlichen Sprachen („language") einen eigenen Erkenntnisweg (vgl. Reinmann, in Druck).

there is little discussion of explicitly theoretical methods; an exception is the well-known procedure of conjecture mapping (Sandoval, 2014), in which connections are visualized in the form of a logical diagram between high-level conjectures, their embodiment in interventions is articulated in design conjectures, and the mediating processes and outcomes are described or explained by theoretical conjectures. Conjecture maps force researchers to make the implicit assumptions of an invention explicit and theoretically sound (e.g., Boelens, De Wever & McKenney, 2020). Some authors like Bakker (2018, pp. 46 ff.) treat the question of theory in DBR by discussing options to formulate theoretical results; finally, from my point of view, questions regarding the design (conceiving, developing) are still too little studied. *Design methods* are mentioned in some books and articles on DBR with references to creativity techniques or references to approaches in design thinking; however, reflections on their generic functions or classification systems that could facilitate their use in DBR are hardly to be found.

DBR models such as that of McKenney and Reeves (2012, 2019) identify relatively clearly when or where empirical methods become necessary—for example, in the analysis of a baseline situation and (in any case) in the evaluation of a developed intervention. Locating theoretical methods usually occurs in conception phases and in theory building (e.g., formulating design principles) after analysis phases. References to formative methods are usually located in conception and development processes. Deviating from this, however, Bannan-Ritland and Baek (2008, p. 302), for example, take empirical methods as relevant to the *entire* DBR process, and Bakker (2018, pp. 60 ff.) emphasizes that design is present in *all* phases. My thesis is that a clear and selective location of empirical, theoretical, and design methods in the DBR cycle is difficult to accomplish in a meaningful way. Instead, with the holistic DBR model presented here, I assume, on the one hand, that theoretical and empirical methods are important in *all* fields of action as well as in all playing fields of the present DBR model but in varying emphasis and with different demands on methodological standards. On the other hand, I assume that design activities are to be evaluated differently in comparison to theoretical and empirical work:

design activities are not only ubiquitous in the DBR cycle like empirical and theoretical work, but they constitute the mode of knowledge of DBR.[7] If one understands DBR in this sense as research *through* design (Frayling, 1993), it must be critically questioned how useful it is to methodically reflect design activities on the same level as, for instance, empirical and theoretical work. In my estimation, design must be methodologically situated on a meta-level—as a basic mode (cf. Reinmann, 2020) and anchored in the researcher's background consciousness.

[7] Archer (1979), for instance, sees modeling as a separate way of knowing, besides "notation" and "language" (cf. Reinmann, 2020).

In the following, I take a closer look at the *use of empirical methods* in relation to the fields of action and playing fields of the holistic DBR model (see Table 1) since empirical work is generally discussed most frequently in the question of methods. Here, the greatest uncertainties generally arise, especially for novices. A similar attempt for the use of theoretical methods would first require collecting, describing, and

clustering them more comprehensively, which cannot be done within the scope of this paper.

Tab. 1: Use of methods in relation to fields of action and playing fields of the holistic DBR model.

Semantic fields	Goal setting	Concep-tion	Develop-ment	Testing	Analysis	Goal setting	Concep-tion
Playing fields	Empirical work adapted to design purpose (EA)						
		Empirical work adapted to design purpose (AE)					
			Tends to be "classical" empirical work (KE)				
					Empirical work adapted to design purpose (AE)		
Fields of action	AE						
		AE					
			AE or KE				
				KE			
					KE		

Considering the fields of action between goal setting and conception, conception and development, and development and testing, the use of empirical methods in terms of short or quick tests or reality checks can help keep the design process in DBR flexible and increase the chance of detecting early what does not function (cf. Rees Lewis et al., 2020). Empirical work in these fields of action usually occurs in single-case settings, with few people and in short time intervals. The goal here is not to answer predefined big research questions or to test hypotheses derived from theory but to validate whether one is "on the right track." This does not mean that researchers do not proceed in a methodologically comprehensible way, justifying and documenting the procedure, but it does have an impact on the role of standards that have usually been established for research contexts other than DBR. If they do not serve the purpose of DBR, they should not guide action but be adapted accordingly.[8] Thus, one needs a consistent alignment with the methodological core of research *through* design. The fields are defined in the holistic DBR model as larger units in mind, and what has been said might also be suited to those fields in which creative conceiving and concrete developing as well as normative work are core activities.

The field of action between development and testing can be looked at a second time in combination with the fields of action between testing and analysis as well as analysis and goal setting from the perspective of empirical work. In combination with testing and analysis purposes, almost every DBR model highlights that empirical methods are central and provide crucial information about the functionality, effectiveness, or goal achievement potential of conceived and developed interventions. In these fields of action, however, decisions must now be made not only about which empirical methods are

[8] McKenney and Reeves (2019, pp. 173 ff.) locate empirical methods in the core process of "evaluation and reflection" but distinguish different evaluation functions (alpha, beta, gamma) to which they assign evaluation strategies; empirical methods are used to implement them. As a consequence, the claims for the use of methods may also

appropriate but also about which associated standards fit the scope of the trial, the quality of the data, and the goal of the analysis (see also Hoadly, 2004). As investigations become larger, and interventions and the theoretical assumptions in DBR become more mature, the purpose of empirical work may become more aligned with that pursued in classical empirical approaches. In terms of playing fields, these considerations are equally valid for those fields in which practical testing and rational analysis are the focus.

6.0 The model and design objects

DBR projects in higher education can relate to vastly different interventions, which are or become design objects in DBR. The following examples of higher education (the list can be broadly added) give an impression of how different interventions or design objects can be (Reinmann, 2018): an infographic to illustrate a complex issue; a group method for face-to-face courses; a digital tool to assess one's own learning progress; an examination format to assess research skills; an instructional video to explain a reading technique; a seminar concept to particularly promote self-organization; a procedure to coordinate instructional planning; a curriculum for the introductory phase of studies; a technical infrastructure to support research-based learning; a collection of tasks to reflect on internship experiences; a feedback concept to accompany student research projects.

Each design object has its own *internal structure* in the sense of an assemblage that can comprise parts that are more or less independent of each other, which, considered as a whole, can relate to each other and can be mutually dependent on each other. In this sense, the exemplarily listed design objects from higher education have a highly different internal structure:

- Infographics, instructional videos, task collections, or digital tools, for example, already describe quite specifically what is meant. Their internal structure is easy to describe; a design core (conception, development)[9] may be quickly worked out.
- Seminar and feedback concepts, examination formats, technical infrastructures, or planning procedures, on the other hand, must first be more precisely differentiated in their possible manifestation. Describing their internal structure is challenging and requires *additional* decisions until an initial design core (conception and development) emerges.

[9] In the 1970s, Flechsig made DBR-like proposals under the umbrella of *praxisentwickelnde Unterrichtsforschung* and introduced the concept of *developmental core* (cf. Flechsig, 1979, pp. 67 ff.).

I would like to illustrate the relevance of the internal structure in more detail by explaining an example: a *seminar concept*. As a term, it is quite undefined since "concept" itself is a rather open word: what belongs to a concept? Seminars deal with topics, pursue goals, have a structure and sequence, give affordances to specific interactions and constrain others, lead to specific results, and so on.

Topics imply certain content, and content is presented in the form of texts, presentations, audios, videos, or interactive artifacts ready to be received and processed by students. Topics and objectives together

form specified syllabi. Course structures and intended processes are materialized in curricula, depicted as verbalized and/or visualized plans. Tasks are needed to initiate interactions, and such task can be aligned with educational methods (problem-based learning, inquiry-based learning, and so on); in turn, tasks include instructions, resources, and perhaps digital systems and tools. Thus, a complex design object such as a seminar concept must be carefully differentiated with regard to its internal structure in order to be able to decide whether the entire arrangement of identified parts becomes a design object, a design focus should be set, or individual parts should be separate DBR objects with their own DBR cycles.

When design objects are to be determined and described, the question is how to deal with the part–whole relationship in particular. Using the holistic DBR model as a basis, there are, in principle, several ways of dealing with complex design objects such as seminar concepts, depending on the internal structure of an intervention and the guiding research questions of a DBR project:

- The whole intervention and its components can be made a design object, thus focusing on the relationships between components and exercising the iterations of *one* DBR cycle.
- In determining the design object, researchers can set a focus within the arrangement of intervention components forming, thus again exercising the iterations of *one* DBR cycle.
- Components of the whole intervention arrangement can be selected, followed by exercising iterations on specific playing fields of the DBR cycle.
- Components of the whole intervention arrangement can be selected and made design objects followed by DBR cycles for each component.

An argument similar to the last two options can be found in Rees Lewis et al. (2020). They argue that complex DBR projects should not be understood as one large DBR cycle; instead, they propose to choose small enough versions of the design to build and test, thus considering small cycles for components of an intervention what they call the principle of "slicing." McKenney and Reeves (2019, pp. 147 f.) also talk about developing prototypes separately for components in the design process and "orchestrating" them. In my opinion, the metaphorical concept of orchestration accurately expresses that, in the end, it is always important to keep in mind both the intervention as a whole (otherwise the claim of orchestration would not make sense) and individual components as possibly independent parts (otherwise orchestration would not be necessary at all). In this case, the core identity of a DBR project (certainly to be defined in more detail in further work elaborating the holistic DBR model) should also be relevant.

7.0 Conclusion

At the beginning, I mentioned the motivation for creating a holistic DBR model for higher education. Considering this, I briefly reflect on

whether and to what extent the model can constructively address the aspects of DBR that have been described as challenging:

(a) The model consistently realizes the iterative-cyclical character of DBR by choosing a circle as graphic representation without suggesting a linear interpretation and by differentiating three types of iteration: the iteration of the DBR cycle as a variation of the whole; the iteration in focused action fields as an oscillation between two focal points; and the iteration between three fields of action, whose realization requires distributed attention and sufficient expertise. (b) The model allows to distinguish different units as part of the whole, which has an impact on handling scientific methods: theoretical and especially empirical methods can be used in the *entire* DBR process, but their standards must be interpreted in the DBR context and thus harmonized with the purpose of action. The fields of action and the playing fields of model are more suitable for deciding specific questions of methods and less for the semantic fields. (c) Some aspects remain open in the present outline of the model: how can we model the relationship of multiple DBR cycles within a complex DBR endeavor? What are the consequences for research practice? How do the resulting part–whole relationships influence the theoretical knowledge production process? The holistic model can help search for problem solutions, and the core identity might perhaps provide some guidance.

My thesis (still to be tested) is that the basic idea of the holistic DBR model presented here as an outline can benefit higher education in both research practice and teaching practice. In higher education *research practice,* I hope that the model will assist in planning and decision-making, especially in larger DBR teams. DBR projects with complex design objects need flexibility in monitoring and controlling processes, which is probably easier to agree on if one shares the idea that different fields of action and playing fields can be considered simultaneously, and different types of iterations can be realized in parallel if needed. At this point, traditional project management frequently and quickly reaches its limits in DBR projects. A holistic view does not yet provide a practicable alternative, but it does provide a communication basis for developing one. In *teaching practice* on DBR, I hope that the holistic model will help students gain a deep understanding of the core characteristics of DBR that distinguish this methodological framework from others. Two of these characteristics should be mentioned separately: first, the prominent relevance of design as a mode of recognition as well as the importance of the chosen design object, which essentially form the core identity of a project and can provide helpful guidance to students; second, the special handling of empirical methods, the role of methods in DBR cycles, and an adequate understanding of their function with the methodological framework of DBR. In my experience, the latter causes problems for many students because they are worried about not reaching the standards of empirical work that they usually know (or assume to know), which is highly unsettling. At best, the holistic DBR model can guide student DBR projects more pragmatically by taking into consideration the different conditions for their own research—for example, regarding the “beginning” and the “end” of the cycle.

8.0 References

Archer, B. (1979). The three Rs. *Design Studies*, 1 (1), 1979, 18-20.

Bakker, A. (2018). *Design research in education. A practical guide for early career researcher*. New York: Routledge.

Bannan-Ritland, B. & Baek, Y. J. (2008). In A. E. Kelly, R. A. Lesh & J. Y. Baek (Eds.), *Handbook of design research methods in education. Investigating the act of design in design research* (pp. 299-319). New York: Routledge.

Boelens, R., De Wever, B. & McKenney, S. (2020). Conjecture mapping to support vocationally educated adult learners in open-ended tasks. *Journal of the Learning Sciences*, 29 (3), 430-470.

Carlson, S. E., Rees Lewis, D. G., Maliakal, L. V., Gerber, E. M. & Easterday, M. W. (2020). The design risks framework: Understanding metacognition for iteration. *Design Studies*, 70, 1-27.

Easterday, M. W., Rees Lewis, D. G. & Gerber, E. M. (2017). The logic of design research. *Learning: Research and Practice*, 4 (2), 131-160.

Euler, D. (2014b). Design-Research – a paradigm under development. In D. Euler & P.F.E. Sloane (Hrsg.), *Design-based Research* (S. 15-41). Zeitschrift für Berufs- und Wirtschaftspädagogik/Beiheft). Stuttgart: Steiner.

Flechsig, K.H. (1979). *Leitfaden zur praxisentwickelnden Unterrichtsforschung*. Göttinger Monographien zur Unterrichtsforschung 1. Göttingen: Zentrum für didaktische Studien e.V.

Frayling, C. (1993). Research in art and design. *Royal College of Art Research*, 1 (1), 1-5.

Herzberg, D. (2020). *Ein Methodenkoffer für DBR*. Vortrag im Forschungskolloquium am Hamburger Zentrum für Universitäres Lehren und Lernen am 05. Juni 2020 (Video). URL: https://www.youtube.com/watch?time_continue=4&v=Ko8sG50jBlk&feature=emb_logo

Hoadly, C. H. (2004). Methodological alignment in design-based research. *Educational Psychologist*, 39 (4), 203-212.

McKenney, S. & Reeves, T. C. (2012). *Conducting educational design research*. Milton Park, Abingdon, Oxon: Routledge.

McKenney, S. & Reeves, T. C. (2019). *Conducting educational design research*. Milton Park, Abingdon, Oxon: Routledge.

Nelson, H. G. & Stolterman, E. (2014). *The design way. Intentional change in an unpredictable world*. London: MIT Press.

Neuweg, G.-H. (2020). *Könnerschaft und implizites Wissen. Zur lehrlerntheoretischen Bedeutung der Erkenntnis- und Wissenstheorie Michael Polanyis*. Münster: Waxmann.

Prange. K. (2005). *Die Zeigestruktur der Erziehung. Grundriss der operativen Pädagogik*. Paderborn: Ferdinand Schöningh.

Rees Lewis, D. G., Carlson, S. E., Riesbeck, C. K., Lu, K. J., Gerber, M. E. & Easterday, M. W. (2020). The logic of effective iteration in design-based research. In M. Gresalfi & I. S. Horn (Eds.), *The interdisciplinarity of the learning sciences, 14th International Conference of the Learning Sciences (ICLS) 2020*, Volume 2 (pp. 1149-1156). Nashville, Tennessee: International Society of the Learning Sciences.

Reinmann, G. (2018). Was wird da gestaltet? Design-Gegenstände in Design-Based Research-Vorhaben. *Impact Free*, 19. Hamburg. URL: https://gabi-reinmann.de/wp-content/uploads/2018/10/Impact-Free-19.pdf

Reinmann, G. (2019a). *Reader zu Design-Based Research*. URL: https://gabi-reinmann.de/wp-content/uploads/2019/12/Reader_DBR_Dez-2019.pdf

Reinmann, G. (2019b). Die Selbstbezüglichkeit der hochschuldidaktischen Forschung und ihre Folgen für die Möglichkeiten des Erkennens. In T. Jenert, G. Reinmann & T. Schmohl (Hrsg.), *Hochschulbildungsforschung. Theoretische, methodologische und methodische Denkanstöße für die Hochschuldidaktik* (S. 125-148). Berlin: Springer VS.

Reinmann, G. (in Druck). Design als Modus des Erkennens: Auf der Suche nach dem epistemologischen Kern von Design-Based Research. In J. Park (Hrsg.), *Design und Bildung – Schriftenreihe zur Designpädagogik*, Bd. 3. München: Kopaed.

Sandoval, W. (2014). Conjecture mapping: An approach to systematic educational design. The *Journal of the Learning Sciences*, 23(1), 18-36.

I gratefully acknowledge valuable feedback from Frank Vohle, the paper's mentor in EDeR's review process, as well as Alexa Brase and Dominikus Herzberg.

Author Profile

Gabi Reinmann is Professor for Teaching and Learning at Universities and Director of the Hamburg Center for University Teaching and Learning at the University of Hamburg. Her main areas of expertise are higher education research (and "Wissenschaftsdidaktik"), research-based teaching and learning (e.g. student research) and design-based research.

Author Details

Prof. Dr. Gabi Reinmann
University of Hamburg
Schlüterstraße 51
20146 Hamburg
Germany
+49 40 42838-9634
Gabi.Reinmann@uni-hamburg.de

Editor Details

Prof. Dr. Tobias Jenert
Chair of Higher education and Educational Development
University of Paderborn
Warburgerstraße 100
Germany
+49 5251 60-2372
Tobias.Jenert@upb.de

Journal Details

EDeR – Educational Design Research
An International Journal for Design-Based Research in Education
ISSN: 2511-0667
uhh.de/EDeR
#EDeRJournal (our hashtag on social media services)

Published by

Hamburg Center for University Teaching and Learning (HUL)
University of Hamburg
Schlüterstraße 51
20146 Hamburg
Germany
+49 40 42838-9640
+49 40 42838-9650 (fax)
EDeR.HUL@uni-hamburg.de
hul.uni-hamburg.de

In collaboration with

Hamburg University Press
Verlag der Staats- und Universitätsbibliothek Hamburg – Landesbetrieb
Von-Melle-Park 3
20146 Hamburg
Germany
+49 40 42838 7146
info.hup@sub.uni-hamburg.de
hup.sub.uni-hamburg.de