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Design Research for Educational Change: Methodologies for Exploring the Future of Learning

Background

Education as a scholarly discipline – separate from Philosophy – was established as the society's demand for an educated workforce of teachers became stronger in the 18th century. Whereas Biology, Physics or Psychology relate to basic phenomena of life and nature, Education, like Economics and Law, is strongly associated with the increasingly complex institution of education: primary and secondary schools, vocational education, higher education etc.. The investment in research in the field of Education, therefore, very often is questioned as to its contribution to the solving of problems in the practical field of education.

Educational Science shares its roots with several disciplines: firstly with philosophical inquiries and historical studies, the tradition of empirical research in Psychology and Sociology, but it also relates to other disciplines, e.g. educational management and economics, technological and architectural aspects related to the infrastructure of schools. All these disciplines have long histories of elaborating a diversity of theoretical approaches as well as research methodologies and methods, standards for scholarly research and communication. Educational Science, then, is situated at the intersection of all these traditions. Over the time, the focus of attention has shifted between the various reference disciplines with their corresponding methodologies: from philosophy and history, to psychology and sociology and other reference disciplines. Although still covering a wide range, the preferred research methods and standards in educational research have changed but without developing a unique methodology of educational science.

Today, the mainstream of educational research is devoted to quantitative and qualitative approaches analyzing individual learning, education institutions and underlying social processes from an interdisciplinary perspective mainly relating to philosophy, psychology and sociology. These analyses provide models and theories to better understand how learning and education function and what are relevant dimensions to explain diversity and inequity. In the 1990s, large scale assessments were started internationally that allow to monitor and compare learning achievements in common subjects in secondary schools. For some participating states, the results of the PISA and other assessments – discussed by a wider public – led to frustration: In these cases, the self-perception of a culture valuing education highly (and spending high amounts of money in education) did not match the results of these tests. This experience motivated a wide discussion of measure to take to improve the quality of learning in schools. Numerous suggestions were brought up by politicians, researchers as well as from the broader public and discussed in the media. Interestingly, these suggestions – based on the same results – could be completely contradictory and all starting points for change seemed plausible: school buildings, curricula, nutrition, teacher training – anything could be argued for. These discussions also showed that the measurement of learning achievements, though illuminating, does not provide sufficient information about possible mechanisms for change. Even more basic, if a plau-

sible model existed explaining the causes and effects of a social phenomenon it is not obvious how to draw a conclusion about the best ways to implement change.

As a consequence of the “PISA-shock“, several public measures for research have been setup. A recent evaluation of the program on empirical educational research by the federal ministry of education revealed the limited impact of this research to the public discussion and changes in the educational system. Therefore, starting in 2018 the federal ministry of education started a new framework for empirical research in education with a distinct focus on change projects, design based approaches and the analyses of success factors for change. The learning lab of University of Duisburg-Essen is responsible for the *meta-project* in the field of digitalization in education, accompanying and supporting the around 50 projects sponsored in this line of research. Furthermore, the meta-project – based on a network of several university and national institutes – is devoted to the joint development of a methodology of design-based research.

Design research in education

A design approach to education is based on the insight that even the most thorough analysis of learning and education does not deliver the necessary knowledge about how to develop learning and education in the field. This insight might be accepted by a larger part of the educational research community, but it still is the question if this knowledge for change is to be understood as an enterprise of a new type of scholarly research or as a problem of application in the practical field – beyond research. Therefore, the establishment of a design approach for educational research is still under heavy discussion, especially since design research approaches are still in its infancy: not all development projects that are somehow being implementing with partners in the field can be interpreted as design research. Furthermore, since design research still is not widely established it is difficult to receive funding for these – still developing – approaches. Therefore, also it is often criticized that we do not possess enough knowledge about change process it is not widely acknowledged that this kind of question also has to be addressed as a research question with a clear methodological focus. Therefore, it is of utmost importance to relate to other disciplines that have a longer tradition in referring to concepts of design.

“Teaching” and “instruction” have been described with reference to liberal arts, an activity that cannot be planned nor explained, emerging from the encounter of person to person. This position, strongly held in a traditional view of education as “Bildung”, has been opposed by a technological view, interpreting teaching as an activity that should follow successful principles of teaching that have been derived from empirical research (vgl. Reiser, 1987). In this case, technology does not refer to technical devices or (digital) media; it refers to the body of systematic knowledge of a domain (e.g. the technology of building bridges).

Both positions have been abandoned. From a perspective of systems theory, Luhman & Schorr (1982) have pointed out the deficit of technology in the professional activity of teachers: The success of teaching does not rely on the quality of the teacher’s interventions alone, it is a co-construction. When we refer to explaining instruction as design then we acknowledge that it should be positioned somewhere between an act of fine arts and a technology. With the first edition of “principles of instructional design” in from Robert Gagné and Leslie Briggs the design perspective on instruction was established. Initially, the seminal work of Gagné and his research group at Florida State University, Tallahassee, was based on research and development in the military – not in the school sector. Therefore, the group was confronted with a completely different set of conditions for teaching and learning, e.g. teaching was more related to “training”; large groups of learners – spread around the world – had to be addressed; standardization had a high priority. With this background, Gagné reached out to using print media and video for instruction in the early 1960s, setting up arrange-

ments that combined classroom teaching with textbook materials, video instructions delivered via TV around the world to large groups of learners. Besides this initial context, the various editions of the instructional design-textbook, that have appeared since, always were broadly addressing the various context of education, but they were not restricted to the perspective of (typically: secondary) school in other ID-models. The did reflect, however, the transition of the theoretical discussion in instructional design from behaviorism to cognitive approaches. However, their approach consistently kept the focus and the starting point of all instructional design on the specification of learning results and then developing the design backwards.

Several models of instructional design have been developed over the years. Andrew & Goodson (1980) were the first to publish a comparison of different models. They found a set of similarities but criticized that the models would not indicate their scope and the operating conditions. They assumed that their design model would be applicable in all contexts, for all topics, ranges, target groups and institutional sector (Lowyck & Elen, 1994).

Dick & Carey (1985) published a model that organized instructional design following a rather generic sequence of steps with the acronym of ADDIE (Analysis, Design, Development, Evaluation). The textbook has been published in many editions since and is typical in viewing the design process as a linear process with distinct stages. The underlying concept of a “waterfall” – as discussed in software engineering – has been questioned in the realm of software engineering: With a waterfall, it follows a strict direction and if it has passed the fall it will not be able to go back. In the development of software, it had turned out that the application of a highly sequential model for organizing the development process could impede with the success of a project (Goodyear, 1994). In a traditional approach, a requirements analysis leads to a software specification which then – in a next phase – is implemented. “Errors” in the design are not anticipated and might question the success of a project, essentially, if detected to late. “Errors” are a disaster are indicators of bad planning. However, in a typical development project in the field of education, they can also be seen as insights that might open the direction to new qualities. This view, however, necessitates an organization of the design process that follows a model that has been discussed as “agile” in recent years. Surprisingly, this line of discussion heavily discussed in computer engineering is not discussed intensively, although it seems attractive to address how to systematically integrate learning in a learning development project.

Kerres (2018) explains that the design process has to be adopted to the conditions of the design project. Routine projects with tight resources, for example, will need different designs than more exploratory innovation projects. He, therefore, phrases the term “design your design”: instructional designers should not follow an instructional design model they have learned. Professional designers should be able to construct of a design model appropriate for a given problem. The model from Kerres does provide criteria when to follow a more sequential or a more iterative model. Essentially, this approach questions the basic assumption that instructional design should follow “the one best” ID-model. It follows empirical analysis of routines instructional designers practice in their fields. The demonstrate that in most cases they do not follow a specific model (and worse: some / many even never have heard of any id-model, but supposedly are still successfully performing their duties. Professionalism in the context of instructional design means creating a flexible approach – based on the state of the art and science of learning and teaching – and reflecting on the results of the routine (which might lead to a reconsideration of these routines).

Approaches to *design-based research* in education

In the 1990s, several educational researchers were confronted with an increasing pressure from funding agencies, foundations and education authorities to deliver more concise and practical results for the educational sector and to make a better contribution to the development of society at large.

Design-based research (DBR) was an answer of the scientific community which gained a lot of approval among the research community. Brown (1992) had introduced the term “design experiments” relating to Stokes (1997), who was referring to “use-inspired basic research” and Pasteur’s quadrant. The paper from the “The Design Based Research Collective” (2003) has been highly cited and the a special issue on DBR in the Journal of the Learning Sciences, introduced by Barab & Squire (2004), with a paper from Collins, Joseph & Bielszyc (2004), received a lot of attention.

Basically, DBR defines the process of research as an iterative course of continuous inquiry and optimization in a number of trials in differing contexts. A DBR project should, therefore, rely on a set of consecutive trials where a certain conceptual model or instructional approach can be tested and improved. The analysis of a new concept for developing reading comprehension, for example, could be tested in a series of consecutive experiments in parallel classes at several schools. This short description shows why DBR received such a high popularity in short time, especially from researchers with a background in quantitative methodology: Proposing a consecutive series of experiments for validating and improving a concept is not challenging a traditional view of empirical research. In general, research has always relied on the idea of a continuous stream of studies – from different research groups – cumulating scholarly knowledge. Therefore, it might be questioned if the basic idea of DBR as an iterative process is adding a new approach to this general perspective. Furthermore, in many cases it simply is not possible to implement a research project as a series of studies, especially with projects that are developing new programs or artifacts (e.g., for digital learning) and in conditions where parallel groups do not exist (which is often typical outside of schools).

On the other hand, we have a long tradition of approaches to social research that are rejecting the idea of learners or teachers being objects of research. Learning and teaching in an educational setting is a complex situation that can not be reduced to scientific models consisting of a set of isolated if-then statements. Instead they perceive research as a complex social interaction between people in different roles. In this tradition of research, several approaches have been developed that differ in their conceptualization of the roles of the various players. In *action research* academia is mainly concerned with building and supporting the development of solutions for practical challenges (Bradbury, 2015; Edwards-Groves & Kemmis, 2016a; McMillan & Schumacher, 2010; Zuber-Skerritt, 2003). With “teachers as reflective practitioners” (Schön, 2017) and the “teachers as researchers” (Edwards-Groves & Kemmis, 2016b) approaches, teachers are trained and supported to setup a research study in their own field. Teacher’s experiences and reflections are valued as constructions of their professional activity in the field. These utterances inform us about the perception of a certain part of the educational field and at the same time they contribute to the creation of the social reality they describe. Research helps to record these views and make them available to others as a source for professional development and critical discussion (Cross, 2007; van Akker & Nieveen, 2017).

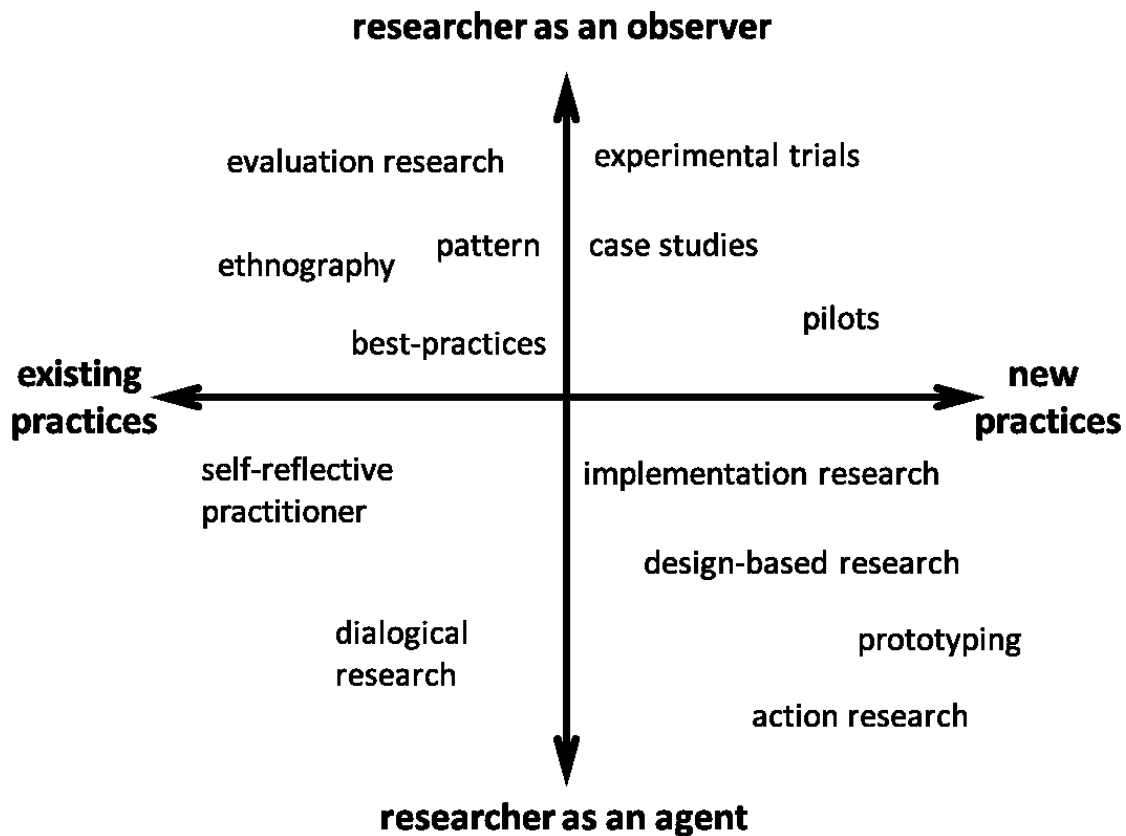


Figure 1: Dimensions of research in the field of education (allocation might vary)

To some extent, current research on teaching and learning essentially is conceptualized as “basic research” in the field of education, without addressing the underlying gap between educational research and practice. But increasingly, researchers follow different paths to actively answer the basic challenge of knowledge transfer. These different approaches can be sketched around two dimensions shown in Figure 1: Researchers are more or less engaged in the field as observers or actors, and they can focus on current or new practices in the field of education. It is important to note, that the analysis of given practices in the field do not automatically yield new directions and do not answer the question how to develop new measures to innovate teaching and learning in the various sectors of education. In recent years, textbooks have emerged that reflect on the discussion of these approaches and provide guidance to researchers in the field of design based research (McKenney & Reeves, 2018; Akker, Gravemeijer, McKenney, & Nieveen, 2006).

Design research in the field of research on “Educational Technology”

Research on Educational Technology has attracted a large interdisciplinary community of researchers bringing together scholars from various backgrounds. In this context, the discussion of design-based research does have an additional connotation since we are addressing the development and delivery of a technical artifact that exhibits certain characteristics on its surface and inside. The terminology of design, in this context, seems to have a closer relation the attributes of these artifacts. However, from the educational perspective, our primary concern are not these obvious attributes that can be “designed”, we are mainly interested in the structural elements a) of the design process in the various stages from planning to implementing in a social environment and b) of the design patterns, models, concepts etc. inscribed into the artifacts. Meanwhile, there are some textbooks related to design-based research in the field of educational technology (Spector, Merrill, Merrienboer, & Dris-

coll, 2007; Clark & Mayer, 2016; Euler & Sloane, 2014; Tulodziecki, Grafe, & Herzig, 2013; Savin-Baden & Tombs, 2017; Beetham & Sharpe, 2019)

At the University Duisburg-Essen's Learning Lab, our focus is on learning innovations with digital technology. "Exploring the Future of Learning" - the slogan describes the mission of our research group. With a staff of about 40 people, the lab is developing digital innovations for schools, higher education and adult education following a design-based approach to educational research based on a dialogue of research and practice. In a previous project, the lab has been involved with meta-analytical approaches to synthesizing educational research on digital learning (Zawacki-Richter, Kerres, Buntins, Bond, & Bedenlier, 2019).

Currently, the lab has received a mandate for the 6-year meta-project „digitization in education“ supporting and accompanying the various research (around 60) projects that are funded by the federal ministry of education and research in the new framework for empirical research in education. Based on an analysis of the effects of earlier funding measures, the federal ministry is aiming at strengthening the impact of funded projects in educational research to answering current challenges in the educational sector. The ministry has established various meta-projects (e.g. in the field of cultural education, professionalization or digitalization) to develop new strategies for the projects to improve exchange between research projects and to increase their outreach, to foster the dialogue between educational research, practice, administration and politics, to improve the public communication and visibility of educational research and to, eventually, increase their impact onto society. Furthermore, the meta-projects will also contribute to the methodological advancement of design-based approaches to educational research. They conduct research workshops and foster the adoption of these approaches and will develop new methods to help and guide the funded projects. The meta-project on "digitization in education" is a joint effort of the national Leibniz-Institutes of Educational Research (DIPF, Frankfurt), of Adult Education (DIE, Bonn) and of Knowledge Media (IWM, Tübingen) with the management at the Learning Lab of University Duisburg-Essen. The presentation will more deeply explain the concept of meta-projects in educational research and its relevance to develop design-based approaches in the field of education on a national scale.

More fundamentally, we will discuss the underlying question what it does mean to conceptualize educational research as a design endeavor? On the one hand, academia has to insist on claiming for "freedom of research" – defining research as an important enterprise for its own sake and not primarily as a service to educational institutions. On the other hand, educational research in many cases does have an interest in contributing to educational change and in delivering insights for these agendas. Therefore, it becomes of utmost importance to develop and reflect on dialogical practices of actors in the field. Over many decades, quantitative and qualitative approaches for social research have been developed and have produced a more or less solid body of acknowledged procedures and quality measures to evaluate research proposals and results. In the field of design-based research in education we are just beginning to establish a debate for developing these measures.

Literature

Akker, J. van den, Gravemeijer, K., McKenney, S., & Nieveen, N. (2006). *Educational Design Research* (1. Aufl.). London: Routledge.

Andrews, D. H., & Goodson, L. A. (1980). A comparative analysis of models of instructional design. *Journal of instructional development*, 3, 2–16.

- Barab, S., & Squire, K. (2004). Introduction: Design-Based Research: Putting a Stake in the Ground. *The Journal of the Learning Sciences*, 13(1), 1–14.
- Beetham, H., & Sharpe, R. (2019). *Rethinking Pedagogy for a Digital Age: Principles and Practices of Design*. Routledge.
- Bradbury, H. (2015). *The Sage handbook of action research*. Sage.
- Brown, A. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *Journal of the Learning Sciences*, 2, 141–178.
- Clark, R. C., & Mayer, R. E. (2016). *E-Learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning*. John Wiley & Sons.
- Collins, A., Joseph, D., & Bielaczyc, K. (2004). Design Research: Theoretical and Methodological Issues. *The Journal of the Learning Sciences*, 13(1), 15–42.
- Cross, N. (2007). Forty years of design research. *Design Studies*, 28(1), 1–4.
<https://doi.org/10.1016/j.destud.2006.11.004>
- Dick, W., & Carey, L. M. (1985). *The systematic design of instruction*. Glenview, Il.: Scott, Foresman.
- Edwards-Groves, C., & Kemmis, S. (2016a). Pedagogy, Education and Praxis: understanding new forms of intersubjectivity through action research and practice theory. *Educational Action Research*, 24(1), 77–96.
- Edwards-Groves, C., & Kemmis, S. (2016b). Pedagogy, Education and Praxis: understanding new forms of intersubjectivity through action research and practice theory. *Educational Action Research*, 24(1), 77–96. <https://doi.org/10.1080/09650792.2015.1076730>
- Euler, D., & Sloane, P. F. E. (Hrsg.). (2014). *Design-Based Research*. Stuttgart: Franz Steiner.
- Goodyear, P. (1994). Foundations for courseware engineering. In R. D. Tennyson (Hrsg.), *Automating Instructional Design, Development, and Delivery*. (NATO ASI Serie F. 119). Berlin: Springer.
- Kerres, M. (2018). *Mediendidaktik. Konzeption und Entwicklung digitaler Lernangebote* (5. Aufl.). Berlin: de Gruyter Oldenbourg.
- Lowyck, J., & Elen, J. (1994). Modelling I.D. research. *Proceedings of the first Workshop of the Special Interest Group on Instructional Design of EARLI*. Gehalten auf der KU Leuven. KU Leuven.
- Luhmann, N., & Schorr, K. E. (1982). *Zwischen Technologie und Selbstreflexion: Fragen an die Pädagogik*. Frankfurt: Suhrkamp.
- McKenney, S., & Reeves, T. C. (2018). *Conducting Educational Design Research*.
<https://doi.org/10.4324/9781315105642>
- McMillan, J. H., & Schumacher, S. (2010). *Research in Education: Evidence-Based Inquiry, 7th Edition*. MyEducationLab Series. Pearson.
- Reiser, R. A. (1987). Instructional Technology: A History. In R. M. Gagné (Hrsg.), *Instructional technology: Foundations* (S. 11–48). Hillsdale, NJ: Lawrence Erlbaum Associates.

- Savin-Baden, M., & Tombs, G. (2017). *Research methods for education in the digital age*. Bloomsbury Publishing.
- Schön, D. A. (2017). *The reflective practitioner: How professionals think in action*. Routledge.
- Spector, J. M., Merrill, D., Merrienboer, J. J. G., & Driscoll, M. (2007). *Handbook of Research on Educational Communications and Technology* (0003 Aufl.). Mahwah, NJ: LEA.
- Stokes, D. E. (1997). *Pasteur's Quadrant: Basic Science and Technological Innovation*. Washington, DC: Brookings Institution.
- The Design-Based Research Collective. (2003). Design-Based Research: An Emerging Paradigm for Educational Inquiry. *Educational Researcher*, 32(1), 5–8.
- Tulodziecki, G., Grafe, S., & Herzig, B. (2013). *Gestaltungsorientierte Bildungsforschung und Didaktik. Theorie – Empirie – Praxis*. Bad Heilbrunn: Klinkhardt.
- van Akker, J., & Nieveen, N. (2017). The Role of Teachers in Design Research in Education. In S. Doff & R. Komoss (Hrsg.), *Making Change Happen: Wandel im Fachunterricht analysieren und gestalten* (S. 75–86). https://doi.org/10.1007/978-3-658-14979-6_9
- Zawacki-Richter, O., Kerres, M., Buntins, K., Bond, M., & Bedenlier, S. (Hrsg.). (2019). *Systematic Reviews in Educational Research: Methodology, Perspectives and Application*. Berlin: Springer Nature.
- Zuber-Skerritt, O. (2003). *New Directions in Action Research*. Routledge.