Design Narratives: An Intuitive Scientific Form for Capturing Design Knowledge In Education

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Abstract

This paper provides a brief introduction to design-based research in education, its rationale and principles. It then highlights some of the challenges in reporting on design research, and proposes design narratives as a suitable form to address these challenges. Design narratives are characterized as a form of scientific discourse, and guidelines are proposed for their construction.

Keywords: design-based research, methodology, narrative, design narratives.

Introduction

The last decade has witnessed a growing trend towards design based research in education and, in particular, on the use of technology in education (Barab & Squire, 2004; Barab, et al., 2004; Bell, Hoadley and Linn, 2004; Béguin, 2003; Brown, 1992; Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003; Collins, 1992; Collins, Joseph, & Bielaczyc, 2004; Edelson, 2002; Lesh and Sriraman, 2005; O'Donnell, 2004; Reeves, 2006; Sandoval and Bell, 2004; Wittmann, 1995). Design based approaches focus on the process of developing innovative tools and activities as means of understanding learning and advancing educational practice. While this trend has moved towards centre stage in recent years, its roots go back to the 1960s.

Christopher Alexander defines design as: "The process of inventing physical things which display new physical order, organization, form, in response to function" (Alexander, 1964, p.1). Middleton et al. characterise the activity of design as "a subtle but complex interaction between the designer and contextual constraints and is accomplished by proposing the <u>form</u> of an artifact, system or process, which in turn drives its <u>behaviour</u>, which in turn can be compared with its desired <u>function</u>" (2008, p. 22, original emphasis). Herbert Simon summarises: "everyone designs who devises courses of action aimed at changing existing situations into desired ones" (Simon, 1969, p 129). The science of education is distinguished by its focus on how learning is induced and directed to a specific agenda. Diana Laurillard identifies the key

challenge for educational research as "how to identify and provide what it takes to learn" (Laurillard, 2008, p 140). This distinction identifies educational science as a study of designed learning. Middleton et al (2008) describe design-based research (DBR) as design processes subjected to standards of scholarship recognised by the scientific community. This definition hides a dual agenda: on one hand, producing better artefacts – material and other - by utilising theory, on the other, advancing theory through the design and use of new artefacts (Bell, 2004). DBR aims to "(a) help design innovations (b) explain their effectiveness or ineffectiveness, theoretically, and (c) re-engineer them where possible, while adding to the science of design itself" (Kelly et al, 2008, p. 5). At the same time "design-based research can advance theories of learning because educational designs embody conjectures about learning that can be empirically refined" (Sandoval, 2004, p. 213). Juuti and Lavonen (2006) identify pragmatism (in the sense of Peirce, 1935) as a philosophical foundation for design based research, leading to an action-oriented conception of knowledge.

Design Narratives

DBR operates "at the edge of chaos"; research settings and problems are complex, messy and often unique. This creates a challenge in terms of the replicability expected of a scientific experiment. Several authors have noted this difficulty and proposed the construct of *design narratives* as a means of addressing it (Bell, Hoadley and Linn, 2004; Hoadley 2002; Barab et al, 2008). The main argument in favour of design narratives is that they provide a "thick description" of the design experiment, allowing critics to assess the validity of the researchers' claims, and trace them back to evidence. At the same time, design narratives provide sufficient contextual information for those who wish to conduct a similar experiment in proximal settings, be they fellow researchers or practitioners wishing to apply the research findings.

Design narratives are accounts of critical events from a personal, phenomenological perspective. They focus on design in the sense of problem solving, describing a problem in the chosen domain, the actions taken to resolve it and their unfolding effects. They provide an account of the history and evolution of a design over time, including the research context, the tools and activities designed, and the results of users' interactions with these. They portray the complete path leading to an educational innovation, not just its final form – including failed attempts and the modifications they espoused. Narrative, notes Hoadley (2002:454), "is only one way of making sense of design-based research" but "to really convey what happened, though, requires a story."

Despite the prevalence of the narrative form in reports of design research (Bannan-Ritland, 2003) it raises several methodological and practical issues. In the words of Shavelson et al.

(2003:25), "there is nothing in narrative form that guarantees veracity". Practically, narrative accounts do not fit well into academic publication format (Reeves et al, 2005). One apparent source of methodological vagueness is the lack of upfront discussion of the narrative tools used by researchers. With a few notable exceptions (e.g. Barab et al, 2008) most studies intuitively use a narrative style of report without explicitly formulating it as a methodology. The term design narrative itself is rarely used, although many papers are in essence design narratives. Even when the form is discussed, it lacks a rigorous definition: what is the core structure of a design narrative? How are its boundaries set? How are events selected and details filtered out? How should we judge if the narrative warrants the researchers' claims?

Another source of difficulty lies within the inherent nature of narrative. In a well-crafted narrative, the message of the story is left implicit (Mor and Noss, 2008). This feature may be epistemically powerful, as it provokes the reader to infer the message and construct her own logical structure to support it. However it is incompatible with scientific discourse, which demands that the path from evidence to arguments to conclusions be exposed to peer scrutiny. The implication is that design narratives are incomplete as a scientific form, and need to be accompanied by a representation of the derived knowledge. Bell, Hoadley and Linn (2004) propose design principles (Kali, Levin-Peled and Dori, 2009), while others (Sharp, Manns, and Eckstein 2003; Retalis, Bachfischer, and Goodyear, 2010; Mor, forthcoming) suggest design patterns. Both are structured abstractions of design knowledge.

Finally, it is important to remember the interpretive quality of narrative. A narrative is not a neutral recount of events; it is the outcome of the narrator's immediate attempt at making sense of events, a conjecture regarding the semantics of occurrences. Arguably, this is common to all manner of organising evidence: the statistical analysis of a randomised experiment reflects the researchers' choice of parameters and variables. Yet in the case of statistical analysis, another researcher using the same choice of material could have produced the same result. A narrative is unique to its narrator. This subjectivity may be appropriate in design research, where the researcher is part of the phenomena, but nevertheless needs to be accounted for.

Towards a Formalisation of Design Narratives

In order for design narratives to provide an effective form of discourse for design research in education, they need to be shaped in a way that would adhere to scientific standards, acknowledge the agenda of design science, and retain the essential qualities of narrative. This may seem a tall order, but in fact carefully designed forms and procedures for design narratives could allow us to align these forces.

A scientific standard demands a transparent audit trail from reliable data to conclusions, and a clear articulation of refutable claims. Where subjectivity is inevitable, it should be reported honestly. A design science stance dictates a functional (pragmatic) focus linked to a value dimension, attention to context and representation, and an awareness of the complexity of human situations. Narrative form entails a clear context description, a protagonist, a plot – a temporally and semantically linked sequence of events – and an implied moral. Combining these three delineates the requirements for design narratives as a scientific instrument. A design narrative is defined by a single problem to be solved or task to be accomplished. I distinguish between two types of design narratives: researcher narratives (RNs) and participant narratives (PNs).

RNs recount a pedagogical problem and its resolution from the researcher's point of view. They are first person accounts of the researcher's experience and observations, in the course of a design experiment. In most cases, the focus is on the design and development of activities, social practices and supporting technology. These elements are seen as an integral unit, under the socio-technical stance that these are inseparable and any partial description would be meaningless for our purpose.

PNs follow the participants in a design experiment – teachers and learners – as designers, contending with problems they encountered in the context of an activity, their use of the resources provided in confronting this problem, and the indications of their learning gains in the process. These are third person accounts based on the learners' written and verbal articulations and my observations.

In a researcher narrative, the protagonist is the researcher, and the narrative would typically be her first-voice account of events. In a participant narrative, the protagonists are teachers or learners participating in the experiment. Although it is often not feasible to expect a full first-person account, an effort should be made to capture the participants' voice.

The two types of narratives are interdependent; the problems encountered by learners and their resolution are the drivers of their learning trajectory. The researcher's problem, from a bird's eye view, is to provide learners with an effective set of problems and the means for resolving them, so as to direct their learning trajectory. Thus, the PNs illuminate and substantiate the RNs. A design narrative should:

- Provide an account of an aspect of a design experiment, from the perspective of the designer / researcher or that of a participant, and, as much as possible, capturing their voice.
- Clearly delineate the context of the design experiment and its educational goals.
- Present a documented record of the researchers' / participants' actions and their effect.

- Incorporate data collected and processed in appropriate scientific methods.
- Decouple reporting events from their evaluation and reflection.
- Be followed by a statement of the derived conclusions, linking them clearly and explicitly back to the narrative.

The conclusion derived from a design narrative is a design claim, i.e. a statement about how to achieve a particular educational effect in a particular context. This claim is external to the design narrative, but it guides the narrator's choice of which events to include in the narrative. Consequently, there can be multiple narratives of the same experiment. All are just as valid, as long as they meet the criteria.

Bruner identifies *Canonicity and Breach* as a defining quality of narrative, arguing that "for to be worth telling, a tale must be about how an implicit canonical script has been breached..." (Bruner, 1991, p 11). In the case of design narratives this implies they should either capture a new solution to a known problem, or a new problem. The uniqueness of the single narrative is complimented by its *Accrual* (Bruner, 1991): the manner in which it connects with other narratives to form a coherent body of knowledge.

Bruner (1991) enumerates ten qualities of narrative: Narrative diachronicity, Particularity, Intentional state entailment, Hermeneutic composability, Canonicity and breach, Referentiality, Genericness, Normativeness, Context sensitivity and negotiability and Narrative accrual (Nardi, 2007; Sinclair, Healy and Sales, 2009). *Canonicity and breach* and *Accrual* have been mentioned above as criteria for delineating the whole set of narratives. The others serve as guidelines in the construction of the narratives themselves. These principles require adaptation in order to comply with the norms of scientific discourse, as illustrated in Table 1.

Table 1: Bruner's (1991) qualities of narrative, with adaptations to serve as guidelines for constructing design narratives

	Bruner (1991)	Adaptation
Narrative diachronicity	"narrative comprises an ensemble of ways of constructing and representing the sequential, diachronic order of human events … its unique pattern of events over time" (p. 6)	Events are clearly dated, with reference to documentation, and reported in chronological order.
Particularity	A narrative reflects on the generic via the specific. It is an account of an incident, not any incident.	Incidents are selected to provide clear and traceable examples of general phenomena. The selection criteria need to be verifiable.

Intentional state entailment	The actions and events portrayed in a narrative must be relevant to the characters beliefs, desires, theories, values, etc. These cannot be observed directly, yet the story derives its meaning from their induction.	First person design narratives include the researchers' account of their intentional state. Any conjectures regarding the intentional state of other agents are supported by interviews and observations.
Hermeneutic composability	The interpretation of a story and the extraction of meaning from it is inseparable from its text, and is part of the implied contract between author and perceiver.	The researcher's interpretation needs to be opened for scrutiny. It is appended to the narrative, while the body of the narrative is kept free of interpretation.
Referentiality	To be accepted a narrative does not need to be a verified recount of reality, but it must convince the reader that is could have been a recount of reality.	Reference had to be convincingly true to actual events.
Genericness	A narrative is associated with a Genre, which provides a framework for its interpretation	The genre of design narratives emerges from the growing tradition of design research in mathematics education.
Normativeness	The problem in the centre of a narrative illuminates a norm by its resolution or in the absence of resolution by contrast.	Design narratives highlight innovations, thus proposing a variation of norms to account for changing circumstances or tensions between existing norms.
Context sensitivity and negotiability	Assumed background knowledge which modulates the narrative's interpretation and the meaning it implies.	The key features of the context are listed, to allow the reader to evaluate it.

Discussion

This paper began with a brief introduction of the design based research (DBR) paradigm in education and, in particular, on the use of technology in education. It provided a definition of the approach and reviewed its history and rationale. DBR operates "at the edge of chaos"; research settings and problems are complex, messy and often unique. This creates a challenge in terms of the replicability expected of a scientific experiment. Design Narratives were proposed

as a scientific instrument, for reporting and interpreting design experiments, which addresses this challenge. Design narratives are accounts of critical events from a personal, phenomenological perspective. They focus on design in the sense of problem solving, describing a problem in the chosen domain, the actions taken to resolve it and their unfolding effects.

Two types of design narratives were identified and charecterised: researcher narratives (RNs) and participant narratives (PNs). Researcher narratives recount a pedagogical problem and its resolution from the researcher's point of view. They are first person accounts of the researcher's experience and observations, in the course of a design experiment. Participant narratives follow the participants in a design experiment – teachers and learners – as designers, contending with problems they encountered in the context of an activity, their use of the resources provided in confronting this problem, and the indications of their learning gains in the process.

A formalism for design narratives was proposed, based on an adaptation of Bruner's (1991) qualities of narrative.

Design narratives offer a much-needed scientific tool for design based research in education. The construction of design narratives is a suitable instrument for the interpretation of the raw evidence arising from the empirical actions. The resulting narratives should be useful in themselves, as exemplars for practitioners and peers. However, in terms of the design research process, they need to be processed further in the course of analysis and evaluation.

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