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## Teachers as Designers of Technology Enhanced Learning

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### Abstract

While the benefits of teacher involvement in designing technology enhanced learning are acknowledged in the literature, far less is known about shaping that involvement to yield those benefits. Research is needed to understand how teachers learn through design; how teacher design activities may be supported; and how teacher involvement in design in various ways impacts the quality of the artifacts created, their implementation, and ultimately, student learning. Existing conceptual foundations for teacher design work are urgently in need of bolstering, and will definitely play a critical role in the future of instructional science. This special issue presents the work of a large collaborative group of researchers, which, since 2012, has explored divergence and convergence among multiple research projects involving Teachers as Designers of Technology Enhanced Learning (TaD of TEL), and has endeavored to extend existing knowledge to strengthen TaD of TEL as a field of research.

### Rationale

For decades, scholarship on factors affecting curriculum implementation has pointed to the importance of involving teachers, to varying degrees, in shaping the learning scenarios in their own classrooms (Ben-Peretz, 1990). At the same time, recent technological developments have changed the nature of teacher design work. Today, teachers design, re-design, and customize not only analogue, but also technology enhanced learning materials and activities. Here, the term, ‘design’ is used broadly, to include the process of mapping and/or actually developing specific resources for teaching or learning. Three main areas of exploration characterize the limited but growing research base on Teachers as Designers of Technology Enhanced Learning (TaD of TEL). These areas are: the *knowledge* teachers have and/or need to engage in design; shaping teacher design trajectories given varied *motives*; and evidence-based considerations for *supporting* teacher designers.

**TaD of TEL knowledge.** Although teachers sometimes design in multi-professional expert teams (Kali, Markauskaite, Goodyear, Ward, 2011), teacher design work is often small scale and near-to-practice. It typically involves: (a) critical reflection on and redesign of one’s personal practice, which teachers find insightful (Davis & Varma, 2008); (b) evidence-based customization (Gerard, Spitulnik, & Linn, 2010); and/or (c) team design within one organization (Voogt, Almekinders, van den Akker, & Moonen, 2005). Teachers working in teams may take on various roles, such as re-designers of existing materials and activities, or co-designers creating completely new ones (Cviko, McKenney & Voogt, 2014a; Penuel, Roschelle, & Shechtman, 2007). Across the various modalities of teacher design work, individuals and teams require different types of knowledge to inform both the process and the products of design.

**Motives for TaD of TEL.** Teachers may choose to become involved in the design of technology enhanced learning for various reasons. First, the designed artifacts can provide resources tailored for use in specific classrooms with particular learners, which can improve student learning (Corcoran & Siladner, 2009; Gerard, Varma, Corliss, & Linn, 2011). Second, teachers often engage in design to achieve curriculum change (McKenney, 2005). Third,

teacher involvement in the design of (innovative) products may be sought to increase their practicality (Könings, Brand-Gruwel, & van Merriënboer, 2007). Fourth, teacher engagement in (technology enhanced learning) design can yield increased ownership and commitment for implementation (Carl, 2009; Cviko, McKenney, & Voogt, 2014b). Finally, consistent with the notions of constructionism (Harel & Papert, 1991), learning by design (Kolodner et al., 2003) and design mode (Bereiter & Scardamalia, 2003), TaD of TEL can provide a rich, authentic and practical context for teacher learning about technology (Koehler & Mishra, 2005) and for professional development; thus, increasing teachers' motivation to engage in this practice.

**Supporting TaD of TEL.** Research has shown that support can contribute greatly to both the processes and the products of TaD of TEL (Nihuka & Voogt, 2012), especially when focused on how to structure work in teams, substantive vision, and process guidance. Analysis of design team conversations has shown that teachers stimulate each other to anticipate and solve practical challenges in early stages of design (Boschman, McKenney, & Voogt, 2014). To establish and maintain the substantive focus for design, a shared vision is essential (De Koster, Kuiper, & Volman, 2012). Conversations about vision and goals stimulate teachers to apply their (technological pedagogical content) knowledge, especially when tackling new topics (Kafyulilo, 2013). Research has demonstrated that high-quality process support is crucial for design success (Kali & Ronen-Fuhrmann, 2011). Support can include: (collaborative) work planning; facilitating meetings; and/or structuring tasks through templates or pre-selected source materials (Huizinga, Handelzalts, Nieveen, & Voogt, 2014).

## Approach

Since 2012, the authors of this special issue have been working together to improve the quality and relevance of research related to TaD of TEL, and to strengthen it as a field of research. Starting at the International Conference of the Learning Sciences in 2012, working groups were formed to synthesize and extend existing knowledge related to various themes in the TaD of TEL field. For two years, the working groups continued their efforts to elaborate key themes in the domain, related to the main areas of exploration described above. One group focused on analyzing the work of teacher designers; this led to a contribution on the first area of exploration - *knowledge* teachers need and use for design (McKenney, Kali, Markauskaite, & Voogt). Three groups focused on specific ways of shaping teacher design trajectories, given varied *motives* (second area of exploration) for engaging in TaD of TEL; this led to contributions on: developing ownership via participatory design (Cober, Tan, Slotta, So, & Könings), teacher customizations to optimize student learning (Matuk, Linn, & Eylon), and teacher learning by collaborative design (Voogt, Laferrière, Breuleux, Itow, Hickey, & McKenney). Finally, one group focused on key characteristics of *support* (third area of exploration) for teacher designers (Svihla, Reeve, Sagy, & Kali). Each thematic contribution, in relation to the three main areas of exploration, is shown in Figure 1.

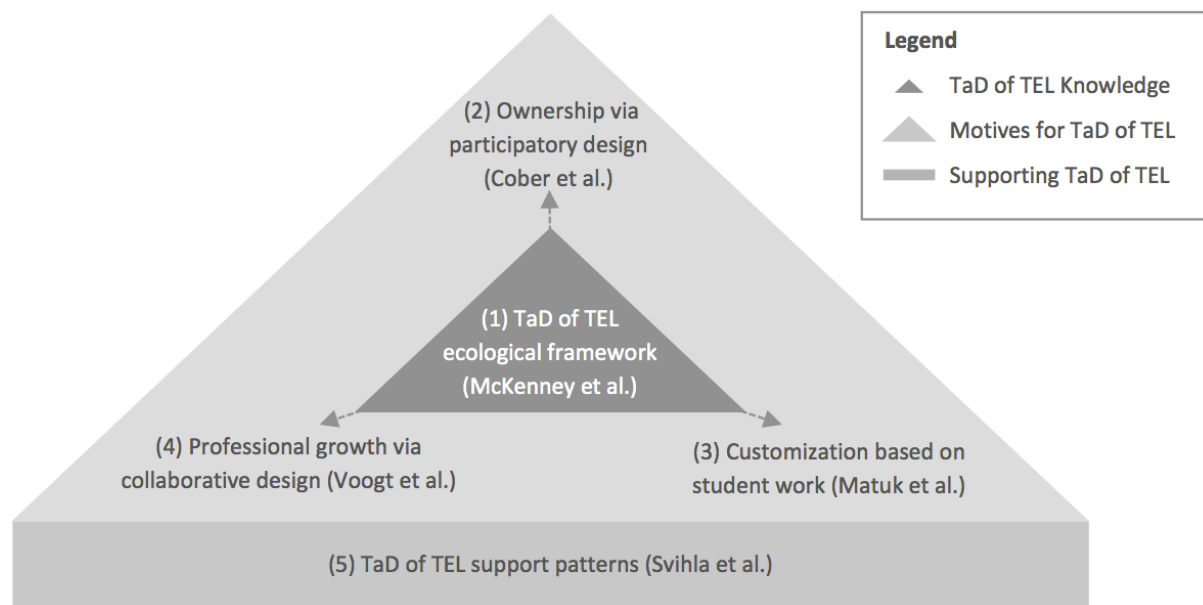


Figure 1: TaD of TEL areas of exploration

In 2014, the above-mentioned themes were further elaborated through discussions with the audience attending an invited session on this topic at the International Conference of the Learning Sciences (Voogt et al., 2014), as well as the excellent constructive comments provided by the anonymous reviewers for the current special issue. As this issue is released at about the same time as a related poster symposium at the annual meeting of the American Educational Research Association (Sagy, McKenney, & Kali, forthcoming), we anticipate that the discussions will continue during, and after the conference. In so doing, we openly invite fellow researchers to join the effort to strengthen the TaD of TEL field of research. In addition to independent work, this could take place through sharing: constructive comments and criticism; responses to this special issue; or contributions for the growing library of resources available online at <https://sites.google.com/site/teachersastel designers/>.

## Overview of the special issue

In accordance with the themes described above, this special issue includes six contributions. The first (McKenney et al.), synthesizes existing research on design and offers an ecological framework for assessing teacher assets and needs in designing technology enhanced learning. To do so, the synthesis draws on design related research ranging from design knowledge in general (e.g., Cross, 2011), to instructional design research (e.g., Ertmer et al., 2008, 2009), and TaD research (e.g., Davis, Beyer, Forbes, & Stevens, 2011). The McKenney and colleagues' framework is termed 'ecological' because it emphasizes dependencies and interactions central to the design challenges tackled by teachers in the complex and dynamic settings in which they work. This contribution advances understanding related to the *TaD of TEL knowledge* area of research.

The second contribution (Cober et al.), studies different aspects of ownership that result from teachers' participation in design practices. This work builds on the participatory design approach as described in early works in a number of fields, including architecture, engineering, public health, and community development (Schuler & Namioka, 1993). It also builds on the participatory design work presented in a previous special issue of *Instructional Science* (2014), and describes how this kind of thinking has been adopted by education

researchers, to involve teachers and students in the design of educational innovations (e.g., Druin 2002; Könings, Brand-Gruwel, & Van Merriënboer, 2011).

The third paper (Matuk, Linn, & Eylon), contributes to a line of research (e.g., Remillard 1999, 2000; Grossman & Thompson 2008), which explores the added value of teachers' re-design of given curriculum materials by making small, systematic adjustments. Specifically, Matuk and colleagues' contribution explains how teachers make customizations of web-based science inquiry projects in ways that take into account student learning with these projects. They also describe technological features that can support such customizations.

The fourth contribution (Voogt et al.), examines how participation in small design teams yields learning opportunities for teachers. Voogt and colleagues draw on the situative perspective articulated by Greeno and his colleagues (1998) and third-generation activity theory as developed by Engeström (1987) to describe and investigate teacher learning by collaborative design. Taken together, the second, third and fourth papers, advance understanding related to the *motives for TaD of TEL* area of research.

The fifth paper (Svihla et al.), contributes to the *supporting TaD of TEL* area of research by characterizing a 'fingerprint pattern' of supports in design courses, and offers guidelines for supporting teachers in the design of technology enhanced learning materials and activities. To develop this characterization, three case study teacher design courses were explored, that despite their differences in contextual aspects and pedagogical approach (e.g., project based learning as described by Brown and Campione, 1994, and the knowledge building communities model as described by Scardamalia, 2002), were found to have similar types of supports for teacher design.

Finally, the sixth contribution, by Kirschner, critically discusses issues that cut across each of the main themes. Taking the role of the devil's advocate, this discussion voices concerns from broader perspectives in educational research, notably (a) challenging the need for technology-specific considerations; and (b) stressing the ecology of education. Key issues receiving critical commentary include: importance of this work; feasibility and variation in existing research; and recommendations for future research.

## Significance of the special issue

Increasingly, teaching is becoming viewed as a design profession, or even a design science, as put by Laurillard (2012): "Teaching is now a design science. Like other design professionals – architects, engineers, programmers – teachers have to work out creative and evidence-based ways of improving what they do" (Laurillard, 2012 abstract). Today's use of technology in schools confronts teachers with additional design challenges. By synthesizing relevant literature and describing recent empirical investigations, this special issue provides clear and timely considerations for those aiming to investigate and/or facilitate teachers as designers of technology enhanced learning. The pathway to this special issue has initiated relevant conversations in person, in print, and online. With its publication and related resources, this special issue constitutes an important step in a much-needed direction to bolster the TAD of TEL field of research.

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