Using Design-Based Research to Solve Wicked Problems

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Abstract: Wicked problem approaches such as problem- and project-based learning initiate robust learning processes. When coupled with design-based research, solutions to educational problems can be iteratively developed and implemented. Research-practice partnerships provide means to engage in this design activity. This paper explains the relationship among wicked problems, design-based research, and research-practice partnerships and how they provide a framework for understanding how research and practice can be reciprocal and why this is valuable in the learning sciences.

Introduction

In the Learning Sciences researchers aim to derive useable knowledge (Barab & Squire, 2004) and find alignment between the principles of learning theory and instructional practice (Schunk, 2000). Accordingly, theories assist in targeting instructional design activities leading to internal consistency as well as orienting the design toward larger theoretical perspectives on learning and the mind. Additionally, researchers and developers leverage theory as a tool to brainstorm ideas or make decisions and justifications about designing instruction. Rigorous research and practice ideally advance theory in ways that ultimately promotes a greater understanding of learning and the effectual design of learning environments (Nathan & Alibali, 2010). Arguably, most importantly, theory provides the framework and grounding for practice. Instead of just mindless action, research and practice can be guided by theory as a set of principles for enhancing and designing learning experiences.

Many educators and researchers note that educational research and educational practice are complementary in that theory informs practice, while practice informs and changes theory (Beetham, 2013; Ertmer & Newby, 2016). This indicates that theory and practice are needed together, that one is not sufficient without the other. When theory does not become realized or observed in practice the effects of an educational intervention can easily be misunderstood while practice without theory can lead to errors and ineffective instructional decisions. In design science, theory and practice are linked together to work toward a given end and accomplish a learning goal (Dewey, 1986; Reigeluth, 1997). Thus, researchers study problems and share results, while practitioners use those results to support solving problems of practice and in turn share their authentic experiences (Wilson, 1997). Theory is often used for sensemaking activities during the design of instruction and its implementation. Understanding why theory is crucial to educational practice and why--in practice--there is uncertainty in the effectiveness of what is theorized (Reigeluth, 1997) is valuable for all educators. The development of theories requires experimentation and testing in real-world learning settings.

This poster presents the connections among authentic problems of practice, problem and project-based learning, design-based research, and research-practice partnerships and why researchers and designers should focus first on authentic problems of practice to inform design instead of pre-designing materials

Wicked problems, design-based research, and research-practice partnerships

Problems used in most design work, as argued by Horst Rittel in the 1960s, are not linear and typically have the properties of *wicked problems* (Buchanan, 1992). Problem-based and project-based learning (PBL) provide instructional models – informed by various theories – for desired forms of learning in science, technology, engineering, mathematics, and many other disciplines that have characteristics of wicked problems. PBL uses real-world problems in instructional practice to frame and guide learning (Barrows, 1996; Krajcik & Blumenfeld, 2006). The use of PBL in educational settings is often carried forward through different lenses such as design-based research (DBR; McKenney & Reeves, 2018) or design-based implementation research (DBIR; Fishman, Penuel, Allen, Cheng, & Sabelli, 2013) for deeper understanding of enactment and outcomes related to practice and theory. Design-based research calls for researchers and partners to iteratively develop solutions to complex educational problems (such as wicked problems or problems of practice), which provides the context to do empirical research on learning with a focus on theoretical understanding.

Design-based research is used as a vehicle to examine the application of theory and principles in order to test theory in educational practice and develop new theories as well as practical tools for learning. Design-based implementation research and research-practice partnerships (RPPs; Penuel & Gallagher, 2017) are needed as extensions for theorizing how to design for learning in organizations and for sustainable implementation of theory-based innovations. Together DBIR and RPPs function at a larger scale and work to inform theory and

educational practice. Consider a district professional development (PD) director working with a researcher to co-design a new PD program. The main problem here lies in the challenge to meet the needs of many teachers while providing engaging PD that will be enacted in the classroom. Using project-based learning to tackle the various needs teachers have to provide more choice, along with micro-credentials to provide evidence to the district, a cadre of teachers co-designed micro-credentials to be iteratively enacted and redesigned while keeping in mind that every action taken in the design and implementation process has real-world consequences. Situated learning guided the co-design and research activities and DBR allowed for iterative improvements. The new PD program met the needs of the district while providing data for research and the specific theory used in the work.

Research and practice reciprocity

Reciprocity in research and practice is essential for improvements to theory and practice. Using wicked problems, design-based research, and research-practice partnerships together provides a robust approach to include theory in practical solutions as well as inform theory based on practical application. Individually all of these approaches are powerful to effect change in education and learning. But together they can potentially be even more powerful in increasing learning and providing design processes that build theory through practice and improve practice because of tested theory. The dynamic between research and practice needs to shift so these areas can work together to inform solutions to complex problems in education. This could be done through partnerships and other collaborations. Changing and applying theory is the responsibility of practitioners, instructional designers, and learning scientists. Only together can change be made.

As major reports call for changes in relationship dynamics between research and practice (Donovan, Wigdor, & Snow, 2003; National Academy of Education, 1999; National Research Council, 2012), more conversations and collaborations are being formed as research-practice partnerships that use design-based research and complex problems to apply reciprocal research and practice activities. This paper has attempted to explain the relationship among wicked problems, design-based research, and research-practice partnerships and how together they provide a framework for understanding how research and practice can be reciprocal and why theoretical work is essential in instructional technology and learning sciences.

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