Motivation in the Learning Sciences: Connecting to Practice by Design

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Abstract: Learner motivation, as a research and design priority, remains relatively marginalized in the Learning Sciences (LS) compared to the discipline's focus on designing for and researching learning. Yet, the learning environments we develop require high levels of motivation. In this conceptual paper, we provide evidence that motivation is marginalized, explain why that might be the case, and provide a way forward that may help ensure our designs better instantiate what we know about motivation in practice. Design-based research (DBR) offers the possibility of connecting motivation research to practice in ways that have not occurred in other disciplines, such as educational psychology. A clearer focus on applying and translating motivation research in design settings will inform our own designs and test motivation theory in ways that are necessary to make motivation more relevant for practice.

Designed learning environments, like those propagated by the Learning Sciences (LS), often require relatively high levels of learner motivation and cognitive engagement compared to more traditional learning settings (Blumenfeld, Kempler, & Krajcik, 2006). In project-based learning, for example, learners need to be active, strategic participants who metacognitively monitor their understanding during extended group inquiry activities that often address real-world problems. Learners in these settings need to be cognitively engaged, not just behaviorally active, in their own learning. Ensuring that our designs support the requisite levels of learner motivation and cognitive engagement is an unmet challenge in LS. Simply put, if we fail to design learning environments that effectively tap, support, develop, and sustain high levels of learner motivation and cognitive engagement, the learning that is the ultimate goal of LS designs will likely remain unrealized, sporadic, or only routine for certain subgroups of learners. After 20 years as a discipline, we still know too little about how to specifically design learning environments that ensure motivated learning for most or all learners.

There are general recommendations in the literature about how one might apply motivation theory and research to practice: learners should be provided with moderate levels of challenge; learners should be offered choices in learning; and learning should be relevant to real-life contexts, just to name a few (Urdan & Turner, 2005). However, the empirical evidence connecting these design principles to learner motivation remains relatively weak (Herman & Gomez, 2006). Furthermore, we have avoided some of the most critical questions that arise when a designer wants to incorporate motivation research in practice. For example, we do not know how to determine if and when a learner perceives a task as being relevant for their lives. We understand the general premise that relevance is important, but we do not know, and have not asked as a field, how to design to ensure that the potential motivating power of working on real-world problems is actualized and sustained for all learners. Too many of the basic questions designers face remain unanswered.

In this paper, we will argue that even though motivation has not been an explicit priority in design, LS, with its focus on collaborative, design-based research (DBR) methods is in a strong position to help test and build motivation theory in learning settings in ways that are not common in existing motivation research paradigms. As a discipline, we need a renewed commitment to ensure LS attends more deliberately to issues of motivation and cognitive engagement in the design of, and research on, learning environments. Doing so should not only improve our designs, but should inform motivation theory in ways that have not typically happened in other disciplines, such as educational psychology, the "home" of much motivation research.

We begin with evidence that motivation is not a common topic in LS research. We then describe challenges associated with applying extant motivation theory and research to traditional classroom practice, and to LS design contexts. Finally, we recommend ways forward that will help to improve our designs, test motivation theory in practice, and develop new, practice-focused theories of motivation.

The Prevalence of Motivation Research in the Learning Sciences

It is difficult to objectively measure the relative importance of a topic like motivation in LS scholarship. We believe, based both on extensive experience as researchers in LS and on our reading of the research, that motivation has to a substantial degree not been a priority of LS compared to its focus on, for example, learning, conceptual change, technology, or other priorities. To better gauge how much LS has explicitly focused on researching motivation and motivation-related topics, we reviewed published articles in the *Journal of the Learning Sciences (JLS)* from its inception in 1991 through 2011, and papers in the published proceedings from the last three conferences of the International Society of the Learning Sciences (ICLS 2006, 2008, 2010). This

review searched all titles that included the keywords "motivation", "identity", "interest", "self-efficacy", "self-regulation", "intrinsic", "extrinsic", "goals", and "self-determination." Though these keywords in titles are not meant to be comprehensive in terms of identifying all articles related to motivation, they should reasonably return an estimate of how much motivation scholarship is represented in these LS venues.

For a comparison with the frequency of other keywords in these same venues, we also searched for terms such as "online", "inquiry", and "design." The motivation-related keywords are much less common. In *JLS*, motivation-related keywords (excluding identity, which is arguably "motivation-related") were present in the titles of 10 journal articles throughout nearly 20 years of publication. "Learning" was in over 400 titles and "design" in over 150. "Engagement" and "Motivation" were present in fewer than 25 titles each.

The relative marginalization of motivation research has been noted by other scholars in LS, including Blumfeld, Keppler and Krajcik (2006) in a handbook chapter and in a recent piece on the impact of design-based research, which found that 13% of titles and abstracts related to motivation themes (Anderson & Shattuck, 2012). Next, we identify reasons why motivation research has not had a greater impact on practice to date.

The Limits of Motivation Research in Impacting Practice

There appears to be a growing awareness that motivation research continues to have a relatively limited impact on educational practice, despite all the progress over the last decades in both theory development and empirical studies of motivation. Recent scholarship (Turner, 2010; Kaplan, Katz, & Flum, 2012) describes challenges that have limited the impact of motivation research on practice. Perhaps the most significant challenge is that motivation theories tend to be underspecified for practice. This under specification, in part, is likely attributable to the fact that motivation theories were typically developed in the disciplines of educational or developmental psychology, and reflect the priorities and methods of inquiry of those disciplines. As such, motivation theories are typically broad explanatory frameworks that describe and account for individual behavior, cognition, and beliefs in various contexts (Herman & Gomez, 2006).

Motivation theories were not primarily developed in practice contexts and thus do not prioritize practice-based challenges and questions that arise for practitioners. For example, one prominent motivation theory, self-determination theory (Deci & Ryan, 2000), has been influential in accounting for the ways individuals behave in contexts in which they are intrinsically, versus extrinsically, interested in a domain. The theory is an explanatory framework that can account for the ways individuals make sense of, act, and particularly, persist, in various contexts, whether those contexts are traditional classrooms, careers, or videogames. There is a strong evidentiary base that when individuals are intrinsically interested in a task or activity, they tend to voluntarily persist in that task longer than others who are extrinsically interested (Deci & Ryan, 2000). But the theory was not developed *per se* to help teachers (or designers) develop and structure learning environments. Self-determination theory, which is relatively better specified than most motivation theories, still remains silent on many of the issues a practitioner would face when applying these insights and theories to a teaching or design context. Some of the questions might include: How can I know what a learners' goals really are?; What are learners' interests?; Is there an important difference between being interested in a way of learning (e.g., group vs. individual) versus the content of learning?

The preceding questions seem related to the theory in fairly direct ways, even if the theory has not been translated well or researched enough to address these questions in practice. A second set of questions also arises, that are critical in practice, but are further afield from the theory, and ignored by motivation researchers. These questions may be critical for practitioners: How will a particular student's focus on extrinsic goals hinder or help a teacher manage instruction, including the behavior management of her class?; How does a teacher think about, and act on instructionally, one person's interest while also being responsible for the management and learning of the whole class?; How can a teacher cover required standards when her students may not be intrinsically interested in particular content? In summary, a motivation lens on practice often raises more questions than it answers. This can lead to frustration for practitioners and marginalization of motivation theory in practice. In fact, it is rare that a motivation theory has the kinds of answers that teachers need (Turner, 2010).

The Learning Sciences has essentially "inherited" motivation theory, constructs, and measures from other disciplines that have not successfully connected motivation research to practice. As a field, we have tended to include these inherited ideas about motivation in our design contexts with varying degrees of success (Herman & Gomez, 2006). But, it is worth wondering to what extent the theories currently "work" in the practice-focused world of LS research and design and how we might benefit by re-examining this inheritance.

There are important cultural differences between motivation researchers and practitioners that can work to limit the applicability of motivation research in practice (Turner, 2010; Kaplan, Katz, & Flum, 2012). The goals, assumptions, epistemologies, values, and purpose of the two enterprises are fundamentally different. In some cases, motivation researchers and practitioners can converge, at least nominally, but in other ways they are strikingly divergent. Kaplan, Katz, and Flum (2012) go so far as to question the enterprise of applying motivation research to classroom settings and raise issues that need to be addressed before motivation research is likely to impact learning practice broadly. Most motivation theories have been developed in research carried

out with individuals, not classrooms. In some classroom research, studies aggregate the responses of individuals on a survey to better understand something about "classroom motivation." But this methodological approach is somewhat troubling when the theory guiding the research was developed to account for individual-level phenomena. Although teachers sometimes work one-on-one with students, much of their instructional time, and thinking, is taken up in small group or whole group instruction. This aggregation of individual experience to group dynamics is a major, largely unaddressed problem of practice. There is, however, a growing number of researchers who adopt sociocultural views of motivation (e.g., Järvelä, Järvenoja, & Veermans, 2008; Hickey, 2003) that focus less on individual processes and more on participatory patterns in collaborative settings. This is a very important new focus of some emerging designs in LS.

The last three decades have witnessed the development of an ever-growing number of motivation related theories and associated constructs. A partial list includes: Goal theory, attribution theory, value theory, social cognitive theory, socio-cultural theory, and self-determination theory. Associated constructs include: Efficacy beliefs, identity, mastery goals, and performance goals, to name a few. Though this proliferation no doubt helps to account for more phenomena in more finely conceptualized theoretical frameworks, the proliferation of theory and constructs and "soft borders" between them also work to increase confusion and, again, may limit application to practice. Because each construct is generally researched separately, we know little about the interactions of constructs in practice. The sheer number of constructs may work against practitioners making concerted efforts to incorporate them into practice. Hearing about these seemingly similar theories often frustrates practitioners, who want to know how they can use these ideas in practice.

A lack of clarity about the malleability of motivation-related constructs also represents a significant challenge. Many theories are unclear or ignore questions related to whether motivation constructs are malleable in learning contexts and whether learning designs need to account for the malleability of constructs. For example, goal theory, with its distinction between Mastery and Performance goals, is unclear about whether goal orientations change or even should be expected to change over the course of, say, a time-limited learning experience. The theory is not clear about whether goal orientations are better thought of as stable, "trait-like" characteristics of learners or whether goal orientations are more variable, "state-like" characteristics. How one conceptualizes goal orientation is then critical to whether it even makes sense to focus on goal orientation in learning settings. Many studies and designs assume that goals are malleable, others do not. In some studies, it is hard to tell because the researchers or designers have simply ignored this important issue in goal theory.

What a teacher or other practitioner believes about motivation is a powerful predictor of whether he or she takes up specific motivation theory in practice (Turner, 2010). If a teacher believes that efficacy beliefs are critical, she is more likely to wonder about ways to build and support high efficacy. In some cases, teachers may possess micro theories about their students' motivation, or about how students learn, that contradict motivation research and make the application of that research to practice, at least in that teacher's classroom, unlikely. Some in LS also have beliefs about motivation that may work to marginalize its application to practice. Since the connection between motivation and learning is underspecified, designers may feel justified in not attending to motivation with the assumption that, "What matters is learning and motivation must have been there if learning occurred." This can be a pervasive mindset that may severely limiting progress in developing practice-based motivation theories. Next, we describe how a focus on design in the context of DBR can begin to address some of the challenges listed above to both improve our learning designs and inform motivation theory.

The Potential of Design to Connect Motivation Research to Learning Practice

There is often an unclear relationship between motivation and learning that creates challenges when designers work to connect motivation theory to practice. We argue that a design focus may move the field of motivation research forward by connecting motivation to practice in ways that have not yet been realized. Design can help test extant motivation theory, better specify existing theory to address practice-based considerations, and develop new practice-focused theories that better account for motivation in learning contexts. In short, we believe a DBR focus on motivation in learning contexts is what is needed to both better ensure the requisite levels of learner motivation and cognitive engagement that will, in part, determine the success of our designs. Also, a DBR focus can inform motivation research in exactly the ways that motivation researchers like Turner argue are necessary. A DBR focus forces designers to be explicit in their choices, and to work with teachers or other practitioners in real world, messy contexts that challenge and stretch existing theories. The designer, who straddles academic and practice settings may be more likely to think deeply about motivation theory, recognizing what needs to be answered in practice, and researching ways to translate motivation into practice in reified designs. Acting as a bridge between academic research and practice has been a role taken on by those in LS in the context of learning theory. It needs to become more of a priority in the context of motivation theory.

Designers can also bring data and insights back from situated, contextualized learning contexts to test, reformulate, or generate theory. As diSessa and Cobb (2004) have argued, the purpose of design studies is to test and inform theory. To date, that testing has largely been focused on theories of learning, but should rightfully also focus on theories of motivation and cognitive engagement. Design contexts offer the possibility

of iteratively informing motivation research about how well theories account for motivated behavior, and can provide rich sources of data about motivation constructs like interest, effort, persistence, and attributions.

In short, design has the potential to move forward motivation theory and the impact that motivation theory can have on improving learning environments. In order to integrate motivation theory with design, we as a field need to take the next step. Thus, in the following section we provide recommendations for moving the field of LS in a direction in which theories of motivation more prominently drive research and design.

Making Motivation Research more Useful in Design: Recommendations

Motivation has slipped to the sidelines in some of the debates about where we should focus our efforts. Although increased learner motivation and interest in learning was one of the original driving forces for developing innovative LS designs, like project-based science, in the 1990s (e.g., Blumenfeld, et al., 1991), there appears to be relatively little explicit focus on motivation in contemporary LS scholarship. There is good reason for some skepticism because designing for cognitive engagement in learning is obviously difficult. Motivation researchers have not solved this challenge for those of us who want to "simply" apply motivation principles to our learning designs. There are still too many unanswered questions about how to leverage motivation research to design more effective learning environments. But, we believe that there has been some progress. We begin with several recommendations that we think are feasible and would ultimately help develop the requisite knowledge base to better connect motivation to practice. Some of the recommendations are certainly easier to implement than others, but we hope they serve to open a discussion across a broad range of participants in LS. We end with a brief description of two studies that incorporate some or all of these recommendations.

Designers need to explicitly address and problematize research questions that are specifically related to testing, translating, or generating motivation theory in practice. Too often, studies in LS are focused on learning and mention motivation in passing, usually as a desired outcome. So, a study of problem-based science might focuses on learners' understanding of the nature of scientific inquiry but also adds "interest in science" as a possible student outcome that their design might support (Herman & Gomez, 2006). In this framing, we may learn very little about ways that teachers can actually build interest in science in practice because those discussions are limited in articles and there is often not data collected to support these discussions. In brief, we argue that if motivation is a driving theory it should appear in research questions, abstracts, and paper titles.

Designers need to be more explicit about their stance on motivation and their view of the relationship between motivation and learning. They need to more explicitly identify how and why they are working to incorporate motivation theory(ies) in their designs. The explicitness needs to be connected to their design rationales, specific design decisions, measurement, and iteration of design. They also need to identify the questions of practice that their work is intending to solve. Designers need to clearly justify why a motivation theory is applicable for a specific design context. For example, designers need to explain why they choose constructs, what they believe about the malleability of constructs over the timeframe, and implementation strength of a design, measurement of constructs, and hypotheses.

Designers need to better understand and document learners' Opportunity to be Motivated (Herman & Gomez, 2006). By this we mean that *we need to better understand learners' actual, not idealized, experience of implementations to understand how motivation is, or is not, supported in practice.* To do so, designers need to develop better context-specific indicators of both the quality and comprehensiveness of an implementation. If we are trying to determine if inquiry increases learners' interest in science, it is important to determine if learners experienced inquiry, for how long, in what ways, and if the motivational principles that inquiry was supposed to support were present in the implementation. For instance, did learners experience meaningful choice over learning, or was choice limited by teacher expertise?

Designers need to better leverage technology to collect information on learners' motivation and explicitly measure changes in motivation. To date, most information about motivation in LS contexts has been through anecdotal reports from teachers ("my kids are really interested in using the technology"), or from surveys or interviews with learners. Less has been done to use the extensive data that some learning environments provide about learner motivation. The kind of data that DBR can generate needs to be better used in understanding moment by moment and across time motivation and cognitive engagement.

Designers need to better understand motivation theory so as to build models of motivation and engagement that include information about influences that are endogenous or exogenous to the designed learning environment. It matters what happens at home and it matters what has happened for the whole life of a learner before participating in the designed learning experience. We cannot account for all of the sources of motivation that are relevant to designed learning environments, but our designs might improve, and we might develop better motivation theory, if we work on the challenge of connecting learners' experiences in the learning environment to the rest of their lives.

Fortunately, there are useful examples of studies that instantiate some of these recommendations and work to build the kind of knowledge base that needs to be constructed to improve design and theory. Habgood and Ainsworth (2011), in a paper on videograme learning, clearly focus on researching a motivation theory (self-determination theory) in a design context. They are explicit about the theory, what they are testing, how they measure and conceive of motivation, the explicit design decisions that influenced their effort to instantiate and test the notion of intrinsic integration in practice and, their understanding of the relationship between motivation and learning.

Allen (2004), in a museum setting, describes design efforts to increase visitors' cognitive engagement with exhibits. Visitors had complete volition over which exhibits to visit, for how long, and for which they could choose their level of involvement. Allen specifies the motivation theory guiding her work and identifies ways the theory did not work to support the kind of engagement desired. A result of this research is the beginning of a knowledge base that other designers could use to understand how to better leverage visitor (or learner) perceptions of physical spaces to increase cognitive engagement.

Discussion

Design-based research as a paradigm has many affordances that could support an effort to make motivation research more useful for learning practice. The Learning Sciences may be somewhat reluctant to take on this challenge. To some extent, we have passed that challenge off to practitioners and have largely assumed that teachers will figure out how to get the learners to "play the game." We need to do more of that ourselves, both because it is necessary and by doing so, we will develop a knowledge base that will improve our designs. We are not productively leveraging a methodology that might help us get there. Design-based research may be the way to move this agenda forward. Some of what we need to do is to prioritize an explicit focus on motivation and its connection to learning. It is hard, the theories may not hold up, and there are significant challenges in practice, but, as learning becomes more diffuse in form and content, more voluntary and life-long, we believe learner motivation and cognitive engagement will become relatively more important in the design of successful learning environments. When the focus is no longer on students, who must attend school, but learners who can simply "click away" from an elaborate, online learning environment, we need to ensure that we are learning, sharing, and theorizing about how to sustain motivation and cognitive engagement in practice.

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