Theoretical Foundation(s) (required)

You have a great deal of leeway in terms of how theory is defined, but you must make a case for a particular instructional design or learning theory and why you feel it is particularly appropriate for the kinds of work you want to do in your creative project. That will include a definition of the theoretical foundation and can include some empirical work but should be reserved to quick hitting broad base ideas, or empirical work engaged in theory building. Leave the specific findings for your literature review.

Writing Sample 1

Technological Pedagogical Content Knowledge **(TPCK).** In seminal work, Shulman (1987) proposed that effective teachers' knowledge consisted of *pedagogical knowledge* (PK), *content knowledge* (CK), as well as their important intersection, *pedagogical content knowledge* (PCK). The latter comprises knowledge of how to effectively teach specific content areas (e.g., knowledge of common student misconceptions when learning Newton's laws).

Recent work posits additional important categories of teacher knowledge in a 21rst century world, called *technological knowledge* (TK), as well as their intersections, or *technological pedagogical content knowledge* (TPCK) (Koehler & Mishra, 2005). The latter comprises knowledge about *how* to effectively teach particular content areas using technology. In addition, the technological pedagogical content knowledge (TPCK) model posits that, when combined, TPCK is greater than the sum of its parts, and that effective TPD interventions integrate the three knowledge types (TPC) rather than de-contextualize them.

> **Comment:** Have a core definition. Make it stand out better than this one.
>
> Like that it is supported with references.

Since developing the initial teacher professional development model in 2004, new literature on professional development, combined with the results of our evaluation studies, suggest that the workshop model must be revised to better support teachers designing pedagogically appropriate activities with online STEM resources. To date, our TPD has focused on technological knowledge. While important, this approach did not guarantee that teachers learned, or already possessed, strategies for effectively integrating pedagogy with NSDL resources to support student learning. As a result, many of the IA projects designed by teachers to date have been of variable quality, and often simply consisted of pointers to additional NSDL materials loosely linked to classroom goals.

> **Comment:**
> Perhaps more appropriate for literature review.

Problem-Based Learning. The theory of TPCK also complements problem-based learning (PBL). PBL is a well-established **inquiry-oriented instructional method**, originally developed in medical education, and now used in K-12 and university settings (Savery, 2006).

> **Comment:** Decent rationale for use of TPCK as a theoretical foundation.

> **Comment:** Ok the bring in a second theory but you need to be careful about space.

In PBL, learners acquire knowledge through engaging with authentic and challenging problems in cooperation with their group members (Barrows, 1986, 1996; Savery, 2006). Typically, learners operate in small groups to solve authentic problems using resources (including online resources) made available to them. The instructor acts as a facilitator,

and provides scaffolds and coaching. Each problem cycle concludes with a reflection phase, in which learners discuss the effectiveness of their solution strategies.

Overall, problem-based learning approaches have been successful in promoting student learning. In particular, meta-analyses of PBL studies show that students are able to perform about as well as their lecture based counterparts on concept level assessments. When asked to perform at a deeper level, for example understanding the relationships and dependencies between concepts, or applying knowledge, students who learned using problem based learning performed at much higher level (Walker & Leary, 2008).

In addition, problem-based learning is an excellent fit in our target context because results from studies involving middle to high school level STEM students strongly favor problem-based learning over the traditional lecture. Several studies have examined student learning in the context of STEM content areas with a PBL intervention (Akinoglu & Tandogan, 2007; Chang, 2001; Dods, 1997; Gordon, Rogers, Comfort, Gavula, & McGee, 2001; Visser, 2002; Ward & Lee, 2004; Williams, Hemstreet, Liu, & Smith, 1998). Across these, the weighted effect size across learning outcomes is quite high ($d = 0.96$).

Finally, PBL has been used with great success with teachers learning technology skills and designing activities for students. Indeed, past work in teacher education that utilizes PBL (Derry, Hmelo-Silver, Nagarajan, Chernobilsky, & Beitzel, 2006; Gulseçen & Kubat, 2006; Shoffner & Dalton, 1998) shows a weighted effect size that is extremely high ($d = 1.14$).