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A multi-case study of a problem-based learning approach to teacher professional development

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A MULTI-CASE STUDY OF A PROBLEM-BASED LEARNING

APPROACH TO TEACHER PROFESSIONAL DEVELOPMENT

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by

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TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

Page

DEDICATION

This dissertation is dedicated to my husband, Marc, and my sons, Matt, Cory, Joshua, Lucas, and Kian. Their support and love encouraged me throughout my doctoral journey.

I also dedicate this dissertation to Judi Kledzik. She was my cheerleader, advisor, coach, mentor, and support. She kept me on track and never gave up on me. Saying thank you is not enough to express all the gratitude I feel. Thank you, Judi, from the bottom of my heart for your support and guidance.

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ABSTRACT

Although professional development (PD) is critical for teachers to develop as professionals, many teachers do not receive PD that is beneficial to their learning. Research demonstrates that effective teacher PD is PD that promotes active learning, emphasizes collaboration, is sustained over time, is correlated to teachers' specific contexts and curriculum, and is coherent with the school as a whole. For the purposes of this study, the theoretical framework of constructivism was used, focusing on the learning theories of Dewey and Vygotsky. Problem-based learning (PBL) is an approach to learning that draws on the principles of constructivism. A PBL approach to teacher learning incorporates the characteristics of effective research-based PD. The researcher used a multi-case study design to explore the phenomenon of how PBL as an approach to teacher learning can be used to develop effective PD at XYZ Elementary School. This study also investigated how teachers' epistemologies may be interrelated to how teachers make sense of a PBL PD approach to learning. Data was collected by means of teacher interviews, teacher belief vignettes, teacher beliefs questionnaire, and PBL PD meetings.

The three teacher participants' case studies provided data for making sense of a PBL approach to teacher development. The first conclusion of this study was that a PBL constructivist approach to teacher PD can be used as a meaningful approach to teacher PD. The second conclusion was that teachers need the following supports to assist their progression through their ZPD: assistance from a supportive other, pressure from respected leaders, intersubjectivity of the learning goal, and coherence with the school. Teachers also need continuity and critical reflection of their experiences. Without these supports, learning conflict and a lack of progression through the ZPD will occur. The third conclusion of this study was that teacher epistemology plays a factor in how teachers participate in a PBL environment. If the PD does not

match the teacher's epistemological beliefs on how people learn, teachers may retreat to the familiarity of their beliefs. Teachers with conflicting epistemologies may only focus on a small portion of the learning task. Also, if teachers believe that the PD is not aligned with the critical contexts of the school, they will most likely not change their existing theories of learning.

Chapter One: Introduction to the Study

Teacher professional development (PD) programs have traditionally operated in a system of direct instruction where teachers passively receive information on new ideas and understandings (Lieberman & Miller, 2000; Little, 1993). These programs typically include top-down decisions, created by administrators and consultants, and are disconnected from the realities of the classroom (Gibson & Brooks, 2012). In the United States, over 90% of teachers have participated in traditional PD programs, which research claims are ineffective for teacher learning (Yoon, Duncan, Lee, Scarloss, & Shapley, 2007). Additionally, most teachers affirm that traditional PD activities are an ineffective approach to their professional learning (Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009).

Research supports the need for a more beneficial and effective PD for teachers. PD strategies that strengthen teacher practice and foster improvements in the classroom is PD that promotes active learning, emphasizes collaboration, is sustained over time, is correlated to teachers' specific contexts and curriculum, and is coherent with the school as a whole (Borko, 2004; Darling-Hammond, Hyler, & Gardner, 2017; Darling-Hammond & Richardson, 2009; Darling-Hammond et al., 2009; Desimone, Smith, & Ueno, 2006; Garet, Porter, Desimone, Birman, & Yoon, 2001; Grant, 1996; Guskey, 2003; Yoon et al., 2007).

The strategies research claims are effective for teacher learning are characteristic of a constructivist learning environment. The constructivist conditions for learning are learners need to examine thinking, construct meaning, reflect on previous understandings, actively participate, question, solve problems, and collaborate with others (Tharp & Gallimore, 2002). In constructivist learning environments, the instructor's role is one of a facilitator. One of the

facilitator's roles is to model metacognitive thinking related to the problem-solving process (Hmelo-Silver, 2003).

Problem-based learning (PBL) is an instructional approach to learning that is true to the central tenets of constructivism (Savery & Duffy, 1995). This approach can be used to structure teacher PD (Lohman, 2002; McConnell, Parker, & Eberhardt, 2013; Zhang, Lundeberg, & Eberhardt, 2011). In PBL, activities are constructed around a problem. Learners take a responsible role in their learning and a facilitator guides the problem-solving process (Hmelo-Silver, 2003; Savery & Duffy, 1995). There are currently only a small number of studies available on the use of PBL as an approach to teacher PD. The few studies that are available show that PBL has a substantial positive effect on supporting teacher learning (Lohman, 2002; McConnell et al., 2013; Zhang, Lundeberg, & Eberhardt, 2011).

Additionally, studies suggest that teachers' perceptions about teaching and learning are derived from and influenced by their epistemological beliefs of teaching and learning (Brownlee, Schraw, & Berthelsen, 2011). Teacher epistemological beliefs range from transmissionist beliefs where knowledge is transmittable, unchanging, simple, and innate to more constructivist beliefs where knowledge is complex, subject to change, learned gradually, and is constructed by the learner (Howard, McGee, Schwartz, & Purcell, 2000; Kang & Wallace, 2005; Schraw, Brownlee, & Berthelsen, 2011).

The aim of this multi-case study is to investigate how problem-based learning can be used as an approach to teacher learning for K-5 teachers at XYZ School. A secondary purpose of this study is to start to investigate how teachers' personal epistemologies may be interrelated to how teachers make sense of a PBL PD approach to teacher learning.

Background

PD for teachers is essential to their development as professionals. The intent of PD programs is to foster the growth of teachers (Ball & Cohen, 1999; Borko, 2004; Darling-Hammond & Richardson, 2009; Darling-Hammond et al., 2009; Yoon et al., 2007). PD is generally considered an important means for improving teaching and learning; however, most teachers in the United States are involved in ineffective PD trainings where the approach is often a short-term, one size fits all, prepackaged, transmissionist style workshop training (Darling-Hammond et al., 2009; Garet et al., 2001). Typically, these episodic, generic workshops fail to connect to anything relevant in a teacher's classroom. Teachers are expected to leave these particular trainings where they are briefly exposed to a new concept or skill and implement what was learned in their classrooms. Teachers are often isolated from one another with limited time for collaboration with colleagues and receive very little support from their districts for help with the new implementation (Darling-Hammond et al., 2009; Fullan & Hargreaves, 1996; Hargreaves, 2000; Lortie, 1975; Musanti & Pence, 2010; Putnam & Borko, 2000; Tharp & Gallimore, 2002).

In a recent study, researchers found that 90% of teachers in the United States participated in a workshop style PD, although most teachers report that it is an ineffective approach to professional learning (Darling-Hammond et al., 2009; Ermeling & Gallimore, 2013; Grant, 1996; Yoon et al., 2007). These types of traditional PD approaches rarely change teacher practice and have no effect on student achievement (Yoon et al., 2007). Research has established that the most beneficial and effective PD that has a potent impact on teacher learning and cultivates improvements in classroom practice is PD that promotes active learning, emphasizes collaboration, is sustained over time, is correlated to teachers' specific contexts and curriculum,

and is coherent with the school as a whole (Borko, 2004; Darling-Hammond et al., 2017; Darling-Hammond & Richardson, 2009; Darling-Hammond et al., 2009; Desimone et al., 2006; Garet et al., 2001; Grant, 1996; Guskey, 2003; Yoon et al., 2007).

The research-based components of effective PD contain many of the characteristics of a constructivist learning environment. Constructivism is a theory about how people learn. It claims that learners use their prior experiences to actively construct their own understanding and knowledge of the world. Construction of knowledge occurs individually and collectively and is the result of interactions, experiences, and reflections (Ackermann, 2010; Jonassen, Davidson, Collins, Campbell, & Haag, 1995; Richardson, 1997; Sudzina, 1997).

Lev Vygotsky's theory of social constructivism has had a large influence on education. His theory of the concept of the zone of proximal development (ZPD) has provided the foundation for learning and instruction in education (Tharp & Gallimore, 2002). Tharp and Gallimore (2002) use Vygostky's theoretical framework to describe the development of higher-order teaching skills. The researchers claim that teachers need a learning environment that is similar to what students need to thrive. They define the ZPD as a four-stage process of learning. Assistance is provided by more capable others, such as facilitators, assisting expert teachers, coaches, or experts to accomplish tasks within the ZPD. As learners move through the stages of ZPD and begin to internalize what was learned, learners will start to rely more on the self and less assistance from the more capable other is needed. Tharp and Gallimore (2002) claim that teacher transmissionist style workshop trainings do not provide for assistance through modeling or feedback. To support teachers' professional growth, teachers require a collaborative environment where they rely on supportive interactions and assistance in the ZPD.

A situative perspective claims that how a person learns knowledge and skills and the situation where the learning takes place is an essential part of what is being learned (Borko, 2004; Putnam & Borko, 2000). Borko (2004) claims that a situative perspective of teacher learning is perceived as teachers being engaged in the practice of teaching and because of this engagement, teachers become more knowledgeable about teaching (Borko, 2004). The key elements of a teacher PD system that are necessary for providing meaning using a situative perspective are the PD program, the teacher-learners in the system, the facilitator, and the context in which the PD occurs (Borko, 2004).

Epistemology is the study of beliefs and methods about acquiring knowledge and learning (Kang & Wallace, 2005; Packer & Goicoechea, 2000; Tsai, Chai, Wong, Hong, & Tan, 2013). Epistemology is relevant for learning because it develops a learner's ways of knowing to help the learner in making sense of problems and challenges that he/she may encounter (Tsai et al., 2013). A learner's perceptions of acquiring knowledge and skills are interpreted through the learner's lens of epistemological assumptions (Hofer, 2004).

Teacher epistemology is defined as teachers' beliefs about pedagogy, the nature of knowledge, and student learning (Luft & Roehrig, 2007; Maor, 1999; Yang, Chang, & Hsu, 2008). Some studies have established that many teachers have a "transmission-type epistemology" that seems resistant to change in the classroom (Maor, 1999). However, other studies have demonstrated that teacher epistemology can change when teachers are involved in PD programs that use a constructivist approach to learning (Howard et al., 2000). It is essential that teacher PD experiences allow teachers to be actively involved in a process of meaning and knowledge construction, as opposed to passively receiving information (Darling-Hammond et al., 2017; Howard et al., 2000; Kang & Wallace, 2005; Keiny, 1994; Luft & Roehrig, 2007;

Maor, 1999). Currently, education is undergoing a constructivist reform, which requires instructional shifts and significant changes in teachers' practice. A transmissionist epistemology can have a considerable impact on a teacher's ability to implement constructivist forms of instruction in the classroom (Howard et al., 2000).

Problem-based learning (PBL) is considered a constructivist approach to instruction that is true to the central tenets of constructivism (Duffy & Cunningham, 1996; Gijselaers, 1996; Hmelo-Silver, Duncan, & Chinn, 2007; Krajcik & Blumenfeld, 2006; Savery & Duffy, 1995). PBL is regarded as "one of the best exemplars of a constructivist learning environment" (Savery & Duffy, 1995, p. 1). In a PBL environment, learning is learner-centered, active, and collaborative (Hmelo-Silver et al., 2007; Savery, 2006). Learners learn content, strategies, and self-directed learning (SDL) skills through problem-solving, self-directed inquiry, and reflecting on their experience (Hmelo-Silver et al., 2007). The facilitator's (more capable other) role is to create an environment that supports "collaborative knowledge construction" (Hmelo-Silver & Barrows, 2006, p. 21). The facilitator guides learners in the learning process, pushes them to think critically, and models higher order thinking by asking the kinds of questions that learners should be asking themselves (Duffy & Cunningham, 1996; Hmelo-Silver, 2003; Hmelo-Silver & Barrows, 2006; Savery & Duffy, 1995).

There are many advantages of PBL as an approach to PD. A PBL approach to teacher learning incorporates the essential characteristics of effective research-based teacher PD. PBL is a means of designing programs using authentic ill-structured problems as the prompt for participant activity (Mulford, Silins, & Leithwood, 2004). PBL is learner-driven yet it is facilitated. Participants develop their own meaningful ill-structured problems that guide their research. Furthermore, the PBL process accommodates participants' learning levels and needs

(McConnell et al., 2013; Zhang et al., 2011). Very few studies are currently available on the use of PBL as a PD model for teachers; however, the few that are available show that PBL has a large positive effect on supporting teacher learning (McConnell et al., 2008; McConnell et al., 2013; Zhang et al., 2011).

Problem Statement

Nine out of ten teachers in the United States have participated in a transmissionist style workshop training (Darling-Hammond et al., 2009). Research has demonstrated that transmission style PD rarely changes teacher practice and has no effect on student achievement (Yoon et al., 2007). Many in-service teachers state that this type of PD is an ineffective approach to their professional learning (Darling-Hammond et al., 2009; Ermeling & Gallimore, 2013; Grant, 1996; Yoon et al., 2007). Even though PD is critical for teachers to develop as professionals, most teachers are not given the quality of PD that would be both useful and beneficial to their learning (Yoon et al., 2007). For teachers to be effective practitioners, they need to regularly expand their knowledge and skills to implement the best educational practices (Harwell, 2003). This requires an approach to PD that has the characteristics and factors of effective teacher learning. Teachers benefit from a constructivist learning environment that requires them to examine their thinking, construct meaning, reflect, be active participants, solve problems, and collaborate with their colleagues (Darling-Hammond et al., 2017). Sadly, effective PD is not commonplace in most districts across the United States (Darling-Hammond et al., 2009). There is a need to find and provide teacher-learning models that implement and utilize research on effective PD approaches that not only empower teachers but also permits them to grow over time.

Purpose

The purpose of this multi-case study was to investigate how problem-based learning can be used as an approach to teacher learning for K-5 teachers at XYZ School. A secondary purpose of this study was to start to investigate how teachers' personal epistemologies may be interrelated to how teachers make sense of a PBL PD approach to teacher learning. Each participating teacher was considered a case. In this study, data was collected by means of teacher interviews, teacher belief vignettes, a teacher beliefs questionnaire, and audio recordings of the PBL meetings and interviews. The first two questions are central to the primary purpose of this study. Question 3 relates to the secondary purpose of this study:

1. What kinds of supports do teachers need during the PBL PD sessions? How does that scaffolding change over the course of the implementation?

2. Which components of the PBL PD model do teachers identify as most effective/ineffective (important) for improving their skills and/or practice?

3. How do teachers' personal epistemologies relate to how they participate in a PBL PD approach to teacher learning? Do teachers show any changes in their epistemologies from the beginning to the end of the experience?

Significance

This multi-case study investigated a new approach to PD, PBL as a PD approach to teacher learning; there is a dearth of literature on this topic. Teachers can benefit from this study because it may lead to new ways for teachers to be actively involved in PD activities that provide meaningful and relevant learning opportunities. Additionally, a PBL approach to learning is essential for teachers because PBL uses authentic, meaningful problems as the stimulus and focus of a teacher learning activity, as opposed to the top-down, disconnected from the realities

of the classroom, transmission style PD that currently dominates teacher PD. Moreover, PBL is based on a constructivist epistemology. PBL utilizes many of the strategies that research has shown to have some effect on changing teachers' personal epistemologies. This study is of value because it also is one of the first projects designed to help fill the gap in knowledge on how a PBL approach to teacher learning may affect teachers' epistemological beliefs.

Research Design

This study used a multi-case study approach (Yin, 2014). Case studies are advantageous since the results are in-depth, empirically rich, and a holistic account of a phenomenon. These accounts can be interpreted into an explanation of the phenomenon, which can aid and help structure future research (Merriam, 2009). This study employed a multi-case study design (Yin, 2014) to explore in-depth how PBL as an approach to teacher learning was used to develop effective PD at XYZ Elementary School. The study proceeded through several stages. All the data within each case was examined so that each case was a unique, holistic entity. The data in each case was analyzed using Creswell's (2013) generic data analysis strategy (p. 185). Once each case was developed and themes identified, cross-case comparisons were made. The data across the cases was analyzed to identify characteristics that were common and also different. The analysis within and across cases assisted in answering this study's research questions. During the last stage, data was synthesized to answer this study's research questions.

The researcher structured the teacher PD to model a PBL approach to teacher learning. The PBL PD experience occurred in a setting with PBL PD facilitated by the researcher. The research included the PBL approach to teacher learning and additionally, whether a PBL approach to teacher learning impacted teachers' epistemological beliefs.

The participants selected for this study were three fifth grade teachers from XYZ Elementary School. Convenience sampling was used because of the participants' accessibility and proximity to the researcher. Data was collected through teacher interviews, teacher belief vignettes, a teacher's beliefs questionnaire, and the PBL PD meetings. A face-to-face interview method was used for the individual semi-structured interviews. Each participant was asked to read the vignette summary during the pre and post PD interview and rate each worldview on a 5-point scale ranging from strongly agree to strongly disagree (Schraw & Olafson, 2003). The teacher's beliefs questionnaire was handed to each participant to complete after the post PD interview. The pre and post PD interview protocols for the study were designed to address research questions and teachers' epistemological beliefs.

Theoretical Framework

For the purposes of this study, the theoretical framework of constructivism was used, focusing on the learning theories of both Dewey and Vygotsky. Constructivism claims that learners are active and use their experiences, and reflections of those experiences, to construct their own understanding and knowledge of the world (Ackermann, 2010; Jonassen et al., 1995; Richardson, 1997; Sudzina, 1997). Constructivist theory posits that knowledge is a function of how learners create meaning from their prior experiences as opposed to someone else externally transmitting existing ideas or values to the learner (Ackermann, 2010; Jonassen et al., 1995; Sudzina, 1997).

Assumptions

The researcher made some assumptions before the project started. This researcher's first assumption was that the teachers will find the PBL PD collaboration time meaningful and beneficial for their professional learning. The second assumption was that teachers will need to

rely heavily on the facilitator for guidance. This assumption was based on Vygotsky's theory of the ZPD, that what learners can do and learn with the support of others exceeds what they can do on their own. Third, this researcher believed that teachers may not want to spend personal time outside the duty day for SDL activities. Lastly, this researcher assumed that a PBL approach to PD will be a useful and effective means for teacher learning.

Delimitations

This multi-case study was conducted with three fifth grade teachers at XYZ Elementary School located in Santa Clara County, California. The teachers were asked to complete a consent form to participate in the PBL PD program and individual interviews. In addition, teachers completed teacher belief vignettes and a teacher's beliefs questionnaire. The interviews, PBL PD meetings, vignettes, and the questionnaire were used in an attempt to discover teachers' actions and interpretations of a PBL PD. Additionally, the researcher sought to determine if teachers' epistemologies affect teachers' perceptions of a PBL approach to PD.

Definition of Terms

Constructivist epistemology: A person who believes that knowledge is complex, subject to change, learned gradually, and is constructed by the learner (Howard et al., 2000).

Facilitator (for PBL): The facilitator guides learners in the learning process, challenges learners to think deeply, and models higher-order thinking skills. The facilitator oversees the group's dynamics and checks that the learning process does not stagnate. The facilitator makes essential characteristics of expertise visible and clearly demonstrates his/her thought processes. Learners work on problems in small groups guided by a facilitator (Hmelo-Silver, 2003).

Ill-structured problem: Ill-structured problems have the characteristics of problems typically found in professional practice (Lohman, 2002). Ill-structured problems are those

problems without a single correct solution and require learners to investigate multiple solutions (Hmelo-Silver, 2004).

Problem-based learning: PBL is "an instructional learner-centered approach that empowers learners to conduct research, integrates theory and practice, and applies knowledge and skills to develop a viable solution to a defined problem" (Savery, 2006, p. 9).

Self-directed learning: SDL is "a process in which individuals take the initiative, with or without the assistance of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes" (Knowles, 1975, p. 18).

Teacher epistemology: Teacher epistemology concerns teacher beliefs about pedagogy, the nature of knowledge, and student learning (Yang et al., 2008).

Teacher professional development: Teacher development is the professional growth a teacher acquires due to increased experience and regularly examining his or her teaching both through regular opportunities and systematic experiences that promote professional growth and development (Villegas-Reimers, 2003).

Transmissionist epistemology: A person who believes that knowledge is transmittable, fixed, quickly learned, simple, and isolated bits of information (Howard et al., 2000).

Zone of proximal development: The ZPD is the difference between what a learner can do without help and what he or she can do with help, the support of the environment, of others, and of the self (Tharp & Gallimore, 2002).

Organization of the Study

This paper encompasses five sections. Chapter One provides an introduction and overview of the study which includes, but is not limited to, the purpose, definitions of key terms,

significance of the study, theoretical perspective, and a brief description of the methodological approach to the study. Chapter Two, the Literature Review, grounds the study in existing and relevant scholarly literature. Chapter Three, Methodology, discusses the methodology or research design that was used in this research study, for instance, data collection, the researcher's role, sampling, informed consent, analysis procedures, and ethical considerations. Chapter Four, Description and Understanding of Cases, presents the results of the analysis. Last, Chapter Five, Discussion, provides the results in light of the research questions, implications of the research, recommendations for practice, and a discussion of the findings.

Chapter Two: Literature Review

The main purpose of this multi-case study was to investigate how problem-based learning can be used as an approach to teacher learning for K-5 teachers at XYZ School. A secondary purpose of this study was to start to investigate how teachers' personal epistemologies may be related to how teachers make sense of a PBL PD approach to teacher learning. The content and organization of this comprehensive literature review includes the following: (a) teacher PD and PD strategies that strengthen teacher practice and fosters improvements in the classroom; (b) the conceptual framework for this study; (c) Vygotsky's constructivist theory; (d) a situative perspective of teacher learning; (e) teacher epistemology and its influence on instructional practices; (f) problem-based learning as a constructivist strategy for structuring learner's experiences; (g) problem-based learning as an approach to teacher PD; and lastly (h) a chapter summary.

Teacher Professional Development

There is a considerable amount of diverse literature on teacher PD. Although previous research has demonstrated the effective characteristics that promote improvements in teacher practice the dominant approach to PD has been short-term, one size fits all, prepackaged workshop training model (Garet et al., 2001). Nine out of 10 teachers in the United States have participated in this form of PD although most teachers state that it is an ineffective approach to professional learning (Darling-Hammond et al., 2009; Ermeling & Gallimore, 2013; Grant, 1996; Yoon et al., 2007).

Many districts and schools choose a one size fits all workshop training model because it is a simple means of quickly disseminating information in a hierarchical manner to a broad group of teachers. District PD is commonly accountability and compliance driven where teachers are

required to work on mandated district initiatives such as new curriculum material training or high-stakes test preparation (Ermeling & Gallimore, 2013). Many times districts will hire consultants to present workshop trainings on themes or discrete topics. However, these particular types of trainings are often found lacking since they are unrelated to the context of teachers' classrooms (Ball & Cohen, 1999; Brown & Ferrara, 1986; Darling-Hammond et al., 2009; Guskey, 2003; Lieberman, 1995; Little, 1993; Putnam & Borko, 2000). Even when teachers are given a catalog of offerings from which to choose, the workshop trainings typically focus on discrete topics or abstract ideas where teachers are left to make the connections to their classrooms on their own (Burbank & Kauchak, 2003; Darling-Hammond et al., 2009; Ermeling & Gallimore, 2013; Grant, 1996). Over 90% of teachers in the United States regularly take part in a one size fits all workshop training approach to professional training despite research that indicates that a workshop training style of PD is ineffective (Darling-Hammond et al., 2009). In their summary of over 1,300 studies, Yoon et al. (2007) found that workshop training PD approaches rarely affect teacher practice and has no effect on student achievement.

      Professional development approaches. Research demonstrates that the most useful and effective PD that has a strong impact on teacher learning and fosters improvements in classroom practice is PD that promotes active learning, emphasizes collaboration, is sustained over time, is correlated to teachers' specific contexts and curriculum, and is coherent with the school as a whole (Borko, 2004; Darling-Hammond & Richardson, 2009; Darling-Hammond et al., 2009; Desimone et al., 2006; Garet et al., 2001; Grant, 1996; Guskey, 2003; Yoon et al., 2007). Subtle pressure is also necessary to motivate teachers to change (Guskey, 1995, 2002). It is critical for the development of teachers as professionals to find and use PD models that implement and

support research on effective teacher learning approaches that not only empower teachers but also enable them to grow over time (Harwell, 2003).

Active learning. Active learning originates from the constructivist view of learning that places emphasis on the active role of learners in constructing their own knowledge (Borko, 2004; Ingvarson, Meiers, & Beavis, 2005; Jonassen, 1995; Wilson & Berne, 1999). Active learning is defined as an instructional method that requires learners to engage in the learning process, participate in meaningful learning opportunities, and reflect on what they are doing (Ingvarson et al., 2005; Prince, 2004; Wilson & Berne, 1999). Lieberman (1995) explains that teacher learning may be more similar to the ways that students learn than was previously understood by learning theorists. Furthermore, she posits that people learn best as a result of active involvement and by reflecting about and by communicating what they have learned. Active learning is a feature of high-quality teacher PD programs (Darling-Hammond et al., 2017; Darling-Hammond et al., 2009; Garet et al., 2001; Ingvarson et al., 2005; Porter, Garet, Desimone, Yoon, & Birman, 2000; Wilson & Berne, 1999). In addition, when PD programs provide opportunities for active learning, this, in turn, strengthens the effect of PD activities that focus on higher-order thinking strategies (Garet et al., 2001; Porter et al., 2000; Wilson & Berne, 1999).

Teachers should be regarded as active learners who construct their own understandings (Lieberman, 1995; Wilson & Berne, 1999). It is essential that teacher PD programs provide opportunities for active learning by allowing teachers to become actively engaged in meaningful discourse, planning, and practice (Garet et al., 2001; Ingvarson et al., 2005; Lieberman, 1995; Wilson & Berne, 1999). In addition, teachers need to be actively involved in problem-solving, which promotes higher critical thinking skills such as analysis, synthesis, and evaluation (Garet et al., 2001; Lieberman, 1995; Porter et al., 2000). PD programs must be structured so that

teachers are encouraged to engage and participate, and where knowledge is acquired through active learning experiences with the surrounding environment in order to allow teachers to develop their own understanding of the topic and make sense of what they are experiencing (Ingvarson et al., 2005; Lieberman, 1995; Wilson & Berne, 1999). Active learning in PD programs should be structured to include opportunities for teachers to observe expert teachers, be observed teaching, plan classroom implementation, plan how new curriculum materials and new teaching methods will be used in the classroom, review student work, and to present, lead discussions, and engage in written work (Birman, Desimone, Porter, & Garet, 2000; Garet et al., 2001). Active learning in teacher PD programs enables teachers to transform their teaching instead of accumulating strategies without the opportunity for teachers to practice and reflect on them (Darling-Hammond et al., 2009).

Peer collaboration. Another essential component for effective teacher learning is teacher PD that is designed to facilitate peer collaboration (Burbank & Kauchak, 2003; Grant, 1996; Lieberman & Miller, 2000; Musanti & Pence, 2010; Nelson & Slavit, 2008; Richardson, 2003; Shulman & Shulman, 2004). Stahl, Koschmann, and Suthers (2006) define collaboration as learning which "involves individuals as group members but also involves phenomena like the negotiation and sharing of meanings—including the construction and maintenance of shared conceptions of tasks—that are accomplished interactively in group processes" (p. 411). Collaboration is especially important with our rapidly changing world (Lieberman & Miller, 2000; Roach, 2013). This rapid change makes it difficult for individual teacher autonomy and self-sufficiency as a means of responding to the increased and complex changes in what teachers are expected to teach today (Hargreaves, 2000; Roach, 2013).

The predominant characteristic of teaching in the United States is individualism, which breeds a culture of isolation among teachers (Darling-Hammond et al., 2009; Fullan & Hargreaves, 1996; Hargreaves, 2000; Lortie, 1975; Musanti & Pence, 2010; Putnam & Borko, 2000; Tharp & Gallimore, 2002). Collaboration is generally not taught nor modeled in pre-service teacher education coursework (Fullan & Hargreaves, 1996; Goddard, Goddard, & Tschannen-Moran, 2007; Lortie, 1975; Tharp & Gallimore, 2002). Lortie (1975) describes how teachers have worked in isolation since the colonial times. He coined the phrase "egg-crate school" (p. 14) where teachers are expected to teach students a specified curriculum without any help from others. This "private ordeal" (Lortie, 1975, p. 73) holds limited opportunities for collegial relations and collaboration. Isolation creates an environment of distrust and feelings of uncertainty and powerlessness when teachers are confronted with decisions, issues, and problems that teachers are not involved in and do not fully understand (Fullan & Hargreaves, 1996; Hadar & Brody, 2010; Lieberman & Miller, 2000; Lortie, 1975; Snow-Gerono, 2005). Isolation is the greatest barrier to improving teaching and learning in schools because isolated teachers must rely on the trying of one thing or another until something succeeds (Goddard et al., 2007; Lortie, 1975) or on teachers' own memories of schooling as a model for teaching (Goddard et al., 2007; Tharp & Gallimore, 2002).

Goddard et al. (2007) believe that the most important outcome of teacher collaboration is that teachers learn how to improve their pedagogical practice. Futernick (2007) observed that teacher retention rates and teacher satisfaction improved in schools that fostered collaboration among teachers. He concluded that teachers felt greater personal satisfaction when they established strong collegial relationships. Teacher collaboration transforms the private ordeal to a "shared ordeal" (Lortie, 1975, p. 74), whereby teachers develop a common bond and a learning

culture in which teachers work together to address issues and problems (Fullan & Hargreaves, 1996; Lieberman, 1995; Lortie, 1975).

Sustained professional development. Another essential component for improving instructional practice that is related positively to student achievement is sustained PD (Darling-Hammond et al., 2017; Darling-Hammond et al., 2009; Desimone et al., 2006; Garet et al., 2001; Roehrig, Dubosarsky, Mason, Carlson, & Murphy, 2011; Supovitz & Turner, 2000; Yoon et al., 2007). Desimone et al. (2006) assert that sustained PD has emerged to be one of the most crucial and critical components of PD. Sustained PD is defined as a PD activity that encompasses a 16-hour or more time span (Desimone et al., 2006). The PD can be job-embedded and does not need to be completed as one contiguous block (Hanraets, Hulsebosch, & de Laat, 2011). Sustained PD encompasses preparatory activities, teacher independent learning, and follow-up activities where teachers discuss and give one another feedback on new learning. Sessions that are short in length may be added together and are considered sustained as long as there are specified learning goals attached to the activity (U.S. Department of Education, 2004).

Darling-Hammond et al. (2009) state that PD activities which averaged 49 hours over a school year improved student achievement by 21 percentile points; whereas PD activities that ranged from 5 to 14 hours showed no significant effect on student achievement (Darling-Hammond et al., 2009; Yoon et al., 2007). Sustained PD activities allow teachers to gradually integrate what was learned from the activity into the classroom, reflect on their experiences, and expand and develop their pedagogical knowledge (Corcoran, McVay, & Riordan, 2003). Moreover, teachers need time to engage in "sustained sensemaking" (Allen & Penuel, 2015, p. 12) in order to understand and work through the desired goals and strategies of the PD within an organization. Sustained sensemaking help teachers "structure the unknown" (Allen & Penuel,

2015, p. 2). By means of ongoing and sustained collaboration and discourse, teachers resolve uncertainty and doubts and make sense of the change promoted within the PD (Allen & Penuel, 2015).

School context. PD that is correlated to teachers' specific contexts and coherent with the school as a whole supports effective professional learning (Darling-Hammond et al., 2009; Desimone et al., 2006; Garet et al., 2001; Grant, 1996; Guskey, 2003; Lieberman & Miller, 2000; McLaughlin, 1992). Boyd (1992), in her extensive review of the literature on school reform focusing on school context, defines the context of a school as the "weaving together and interdependence" (p. 4) of all the facets of a school. She explains the context of a school as being comprised of two parts: the ecology and the culture of a school. The ecology of a school is the "inorganic elements" (Boyd, 1992, p. 5) that make up a school and have an influence on the people within a school. Some examples of the ecology of a school are available resources, policies (local, state, and federal) and rules, physical arrangements, demographics, and the size of the school.

The second part, culture, is comprised of the social organization of a school. Boyd (1992) states that there are three components that make up the culture of a school. The first component is the attitudes and beliefs that people, both inside and outside of the school, have on school change, students, and other people. The second component of school culture is the cultural norms of a school. Cultural norms are made up of the unwritten and informal rules that dictate behavior in a school and community. The last component is the relationships of the people within the school, such as the relationships between teachers and students, teachers to teachers, or teachers and administrators. Relationships in a school describe the way people regard and behave toward one another, individually and as a group (Boyd, 1992; Clarke & Hollingsworth, 2002).

The "interrelatedness and interaction" (Boyd, 1992, p. 8) of the cultural components and the ecology of the school create the context of a school. Context conditions at a school will affect the outcomes of PD (Boyd, 1992; Clarke & Hollingsworth, 2002; Garet et al., 2001; Guskey, 2003). To improve the effectiveness of a PD endeavor, an understanding of the context of a school is important (Clarke & Hollingsworth, 2002; Guskey, 2003; Lieberman & Miller, 2000). For example, the prescribed curricula that is already established at a school, whether the school is in an economically depressed area versus an affluent area, the textbooks being used in a teacher's classroom, a teacher's educational background, students' cultural backgrounds, a school's procedures for lesson planning or even the various assessments that are required by a district will affect the introduction of a new teaching approach (Garet et al., 2001; Guskey, 2003; Holton & Clarke, 2006). PD endeavors that appear to be very similar may result in different outcomes based on the context of a school. Being aware of the critical contextual elements at a school is necessary for effective PD (Clarke & Hollingsworth, 2002; Guskey, 2003).

Pressure. Guskey (1995) states that of all the facets of teacher PD, subtle pressure is many times the most overlooked. The early stages of an implementation can be very difficult for teachers (Guskey, 1995). Scaffolding combined with subtle pressure is critical to help trigger change. Scaffolding enables teachers as learners to achieve goals that are beyond their unaided efforts (Wood, Bruner, & Ross, 1976). Subtle pressure is also needed to help trigger change for those teachers who are not very motivated to change (Guskey, 1995, 2002). Pressure can provide the encouragement teachers as learners may need to persist in the early stages of an implementation. Subtle pressure can be provided by coaches, administrators, or colleagues. However, the application of pressure depends on the context. Some teachers as learners may need a considerable amount of pressure to overcome inertia or resistance. For those teachers who

are motivated to change, pressure may appear aggressive. Guskey (1995) states that the key to pressure is to find the right balance between the context, culture, and the dynamics of the people involved.

Theoretical Framework

The conceptual framework that guides this paper is the idea that learning, and teacher learning specifically, is a socially constructed process. Constructivism claims that learners are active and use their experiences to construct their own understanding and knowledge of the world (Ackermann, 2010; Jonassen et al., 1995; Richardson, 1997; Sudzina, 1997). Knowledge is a function of how learners create meaning from their previous experiences as opposed to someone else externally transmitting existing ideas or values to the learner (Ackermann, 2010; Jonassen et al., 1995; Sudzina, 1997). Teacher PD programs have traditionally operated in a system of direct instruction where teachers passively receive information on new ideas and understandings (Lieberman & Miller, 2000; Little, 1993). These programs typically are imposed top-down and are disconnected from the realities of the classroom (Gibson & Brooks, 2012). Most teachers state that this is an ineffective approach to their professional learning (Darling-Hammond et al., 2009; Ermeling & Gallimore, 2013; Grant, 1996; Yoon et al., 2007). Accordingly, learners, teachers included, benefit from learning environments that require them to examine thinking, construct their own meaning, reflect on previous understandings, actively participate, question, solve problems, and collaborate with others (Lieberman & Miller, 2000; Little, 1993; Richardson, 1997; Tharp & Gallimore, 2002). In constructivist situations, the instructor's role is one of a facilitator. The facilitator models metacognitive thinking related to the problem-solving process by prompting learners to ask questions, analyze, and arrive at their own ideas and conclusions (Hmelo-Silver, 2003; Jonassen et al., 1995; Savery & Duffy, 1995).

To understand teacher learning from a constructivist viewpoint indicates that teacher PD programs must supply teachers with opportunities for active and social construction on their conceptions of teaching practice.

Constructivism

Constructivism is a learning theory that explains how people acquire knowledge and learn. In constructivism, the learner actively constructs knowledge individually and collectively based on existing beliefs and prior experiences (Ackermann, 2010; Phillips, 1995). Many constructivists consider John Dewey, Jean Piaget, and Lev Vygotsky foundational figures for learning and much of constructivist theory stems from their work (Fosnot & Perry, 1996; Matusov & Hayes, 2000; Phillips, 1995; von Glasersfeld, 1995).

John Dewey (1897) was one of the first to theorize about the need for and benefits of constructivist learning in education. He expressed his beliefs in his earliest writing "My pedagogic creed" (Dewey, 1897). Dewey divided his creed into five articles where each element of social constructivism can be found in his document: What Education Is, What School Is, The Subject of Education, The Nature of Method, and The School and Social Progress (Dewey, 1897). Dewey did not believe in the dominant approach to learning where learning is focused on mastery of content and discourages the natural process of inquiry. John Dewey contended that education should be an empowering process and measured by whether or not it creates a desire for the learner to continue learning (Trotter, 2006). Although Dewey is usually discussed in the literature in the context of students, Dewey's theories are also applicable for teachers, since teacher learning is very similar to the way students learn (Lieberman, 1995).

For Dewey, *perturbations* (problems) are the stimulus for learning (Duffy & Cunningham, 1996). He emphasized that the learner's interest in a problem had to be stimulated,

and learning was then organized around the learner's active effort to find a solution to the problem (Duffy & Cunningham, 1996). Dewey's center of interest was an inquiry-based approach to learning in which he saw the scientific method as the framework for reflective thinking (Rodgers, 2002). Rodgers (2002) gleaned four criteria from Dewey's work that characterize Dewey's theory of reflection:

1. Reflection is a meaning-making process that moves a learner from one experience into the next with deeper understanding of its relationships with and connections to other experiences and ideas. It is the thread that makes continuity of learning possible and ensures the progress of the individual and, ultimately, society. It is a means to essentially moral ends.

2. Reflection is a systematic, rigorous, disciplined way of thinking, with its roots in scientific inquiry.

3. Reflection needs to happen in a community, in interaction with others.

4. Reflection requires attitudes that value the personal and intellectual growth of oneself and of others (p. 845).

Dewey's theories on reflection involve interactions with the self, others, and the learner's environment, which eventually leads to the next learning experience. Dewey termed this occurrence "continuity" (Rogers, 2002, p. 846). Continuity can occur in isolation of others; however, Dewey believed that when continuity occurs in a community, the learner will expand his or her learning, far surpassing where it may go in isolation (Rodgers, 2002).

Dewey frequently mentions in his writings the urgency to develop teachers' professionalism. He believed that, as with any learner, when teachers reflect on their experiences they will understand better what their students are doing and why. Through reflection,

interaction, and continuity, teachers are better prepared to express their own needs and the needs of their students, stand up for their beliefs, and propose actions both inside and outside the classroom (Rodgers, 2002).

From the constructivist perspective, two dominant strands have emerged, cognitive constructivism and social constructivism. While both strands form overall constructivism, both perspectives have different emphases (Powell & Kalina, 2009). Cognitive constructivism came directly from the work of Swiss developmental psychologist Jean Piaget (Powell & Kalina, 2009). Piaget was the first psychologist to make a methodical study of cognitive development (Powell & Kalina, 2009) and his work is considered the beginning point for the cognitive basis of constructivism (Fosnot & Perry, 1996). Piaget's main focus of constructivism has to do with the individual and how the individual constructs knowledge (Powell & Kalina, 2009). Piaget dismissed the proposition that learning is the passive assimilation of bestowed knowledge (Ackermann, 2010; Powell & Kalina, 2009). Instead, he proposed that learning is a dynamic process comprised of progressive stages of adaptation that eventually lead to higher forms of reasoning (Ackermann, 2010; Fosnot & Perry, 1996; Trotter, 2006; von Glasersfeld, 1989).

Social Constructivism

Where Piaget focused on learners constructing their own knowledge through their actions, Lev Vygotsky placed focus on the claim that understanding is social in origin (Blake & Pope, 2008; Matusov & Hayes, 2000; Tharp & Gallimore, 2002). The works of Vygotsky have informed much of contemporary social constructivism in the twentieth century (Packer & Goicoechea, 2000). Not only has Vygotsky's theory had an increasing influence on modern sociological and psychological theory, but also in education. Vygotsky's ZPD has provided the basis for learning and instruction in education (Tharp & Gallimore, 2002). Tharp and Gallimore

(2002) state that although the Vygotskian theoretical framework has mostly been studied in children, skill acquisition using this framework is applicable for people of all ages. The researchers use the Vygotskian theoretical framework to describe the development of higher-order teaching skills. They believe that teachers need a learning environment made up of the same characteristics that students need to thrive. However, it is necessary to understand Vygotsky's theory before discussing how it relates to teacher learning.

Vygotsky (1978) theorized that social interaction patterns are crucial to learning. He proposed that learning takes place first through direct social interactions between individuals (interpsychological) and then individually through internalized processes (intrapsychological) that produce deep understanding (Blake & Pope, 2008; Papaleontiou-Louca, 2003; Tharp & Gallimore, 2002). The learner first works through the details of a problem socially in the presence of supportive others, such as teachers, peers, guides, and coaches. The supportive other(s) guide the learner to mastery where the learner eventually can take the initiative to accomplish these functions independently through self-regulation and self-interrogation (Brown & Ferrara, 1986; Papaleontiou-Louca, 2003; Tharp & Gallimore, 2002).

The most well-known of Vygotsky's concepts is the ZPD (Gredler, 2009). This concept examines the theory that what a learner can achieve with the assistance of others may be more emblematic of a learner's cognitive development than what he or she can accomplish on his or her own (Vygotsky, 1978). Vygotsky (1978) explains that the ongoing tension between learning and development cannot be resolved without the ZPD. The ZPD stimulates internal developmental processes that can only be triggered when a learner is interacting with people in his or her environment and cooperating with his or her peers. Vygotsky (1978) believed that

"what the child [or learner] is able to do in collaboration today, he will be able to do independently tomorrow" (Vygotsky, 1987, p. 211)

Readiness to learn, according to Vygotsky (1978), is not only tied to prior knowledge, but it is also the ability of the learner to learn with the help of others (Stone, 1998). However, Vygotsky never defined a framework for social assistance beyond generic statements about guidance and collaboration (Thompson, 2013). A concept that has developed from Vygotsky's socio-cultural theory is *scaffolding*, a term first used by Wood et al. (1976). Scaffolding is tied to Vygotsky's theory that learning occurs through instruction within the ZPD (Richardson, 1997; Stone, 1998; Van de Pol et al., 2010). Scaffolding was developed as a metaphor (Stone, 1998; Van de Pol et al., 2010) and is defined as the supportive assistance provided to a learner or novice that enables him or her to solve a problem, carry out a task, or achieve a goal that would be beyond his or her unaided efforts (Wood et al., 1976). Once the learner is able to complete or master the task, the scaffolding is gradually removed and the responsibility of learning shifts to the learner. Supportive assistance may necessitate a variety of specific scaffolding strategies that may appear in the process of solving a problem (Bickhard, 2005; Dabbagh, 2003; Holton & Clarke, 2006; Puntambekar & Kolodner, 2005). Not all scaffolding can be provided with any one tool or person, nor is scaffolding always dependent on the physical presence of a more knowledgeable other (MKO; Dabbagh, 2003; Holton & Clarke, 2006; Puntambekar & Kolodner, 2005). Scaffolding can be provided by, for example, peers, available material, software, books, and/or the internet (Holton & Clarke, 2006; Puntambekar & Kolodner, 2005). Duffy and Cunningham (1996) include in their definition of scaffolding "any artifacts in the environment that afford support, as well as the cultural context and history the individuals bring to the [zone

of proximal development]" (p. 15). However, the role of the MKO is essential for successful

learning to occur (Holton & Clarke, 2006; Puntambekar & Kolodner, 2005).

For scaffolding to be effective, the learner must use his or her prior understandings of

what needs be accomplished (Sawyer, 2006; Stone, 1998). More knowledgeable or capable

others try to activate and make use of a learner's capabilities by scaffolding the learner within his

or her ZPD (Bransford, Brown, & Cocking, 2000; Dabbagh, 2003; Duffy & Cunningham, 1996).

MKOs control those components of a task or problem that the learner cannot achieve on his or

her own and therefore permits the learner to focus on the components that are manageable and

within his or her level of competence (Wood et al., 1976). Since the scaffolding of knowledge is

an essential facet of learning, learners need to be aware of the scaffolding process (Bickhard,

2005; Holton & Clarke, 2006). This process is then internalized so that knowledge can be

constructed or problems solved in the future without the assistance of the MKO (Bickhard, 2005;

Holton & Clarke, 2006).

Teacher professional development and the ZPD. Tharp and Gallimore (2002) state that

although the process of ZPD has mostly been studied in children, the ZPD process can also be

seen in adults during skill acquisition. The researchers describe the ZPD as a four-stage process.

Stage 1 is where assistance is provided by more capable others, such as facilitators, assisting

expert teachers, coaches, or experts. During this stage, the more capable other serves as a model

or offers directions to the "acquiescent" (Tharp & Gallimore, 2002, p. 45) learner. At the

beginning of this stage, the learner may vaguely understand or appreciate the sub-goals and end

goals developed in collaboration with the more capable other. Many times the learner will

experience confusion or even self-doubt as the learner works through this stage. Eventually, in

the course of this stage, the learner will understand how the elements of a task relate to one

another. In the case of teacher PD, this understanding is developed by the teacher as learner through conversation about the task, problem, or goal to be achieved. Once this understanding is in place the assisting expert teacher (more capable other) can further assist the teacher by giving feedback, questioning, or some other means of cognitive structuring. As the teacher acquires an understanding of the task, the teacher begins to operate as his or her own "consultant" (Tharp & Gallimore, 2002, p. 251). The assisting expert teacher's role shifts from modeling, offering directions, or giving feedback to providing cognitive structuring of the teacher's analyses and emerging conceptualizations. Stage 1 is accomplished when responsibility shifts from the assisting expert teacher to the teacher where the teacher internalizes and adapts the strategies the assisting expert teacher provided at the beginning of this stage.

Stage 2 is defined as the stage where "assistance is provided by the self" (Tharp & Gallimore, 2002, p. 252). In Stage 2, the learner carries out the task with less dependence on the assisting expert teacher or the environment. However, strategies are not yet internalized at this stage. Learners help guide themselves by using self-directed speech and assume responsibility for self-regulation of their learning. Lifelong learning is characterized by self-assistance where adults regularly talk to themselves and assist themselves by using varied approaches to learning. Self-assistance employs a range of approaches such as seeking feedback, developing standards, imagining models of good solutions to problems, and constructing cognitive structures to give an explanation of events.

Tharp and Gallimore (2002) found that the teachers they studied generally used self-talk as a form of self-assistance. Some frequently used forms of self-talk by the teachers in the study were: self-instruction, self-praise, self-scolding, and self-questioning. Many teachers reported that they tended to use the modeled forms of words or phrases voiced to them by their trainer.

Over time, the trainer's modeled words became the teachers' own particular words and phrases. Teachers transitioned from Stage 2 to Stage 3 once the teachers' inner speech began to diminish and teachers progressed to automaticity.

Stage 3 is characterized as internalization and automaticity. This is the stage where the learner has emerged from the ZPD to manage the task at hand. The learner is able to perform the task smoothly and regulation has been internalized and automatized. Assistance from the assisting expert teacher or the self is no longer needed now and is a disruption to the learner. Performance can no longer develop since it is already developed. Vygotsky describes this as "fossilized" (as cited by Tharp & Gallimore, 2002, p. 38) where internalization and automaticity cannot be changed by social and mental forces. However, this "fixity" (p. 257) is not a permanent state. During this stage, the teachers in the study reported high self-confidence and satisfaction with the skills they have acquired. They enjoy their work, and their values, attitudes, and understandings of their skills are strong and immediately accessible.

Stage 4 is the period where de-automatization leads back to recursiveness through the ZPD. Lifelong learning is typified by recursiveness through the previous three stages as a person develops new capacities. Even accomplished and skilled adults can gain from regulation for enhancement, improvement, and maintenance of their skills. Minor changes to the environment, stress to the individual, major disruptions, or physical trauma may affect the automaticity of a capacity. For example, one teacher in the study had left for summer vacation and when she came back to school she had forgotten the new behavior management skills she had acquired before she left. It was necessary for her to engage in self-talk and give herself self-reminders to resume using the techniques she had been coached to use the previous school year. Self-directed speech, in this case, is a form of recursion that was used to restore competence. The researchers state that

one of the distinguishing features of an excellent school is a system for providing opportunities for teachers to develop expertise and invigorate skills with the recurring assistance of others.

Situativity Theory

Situativity Theory is the framework that posits that learning, knowledge, and thinking are situated in the activity or experience (Brown, Collins, & Duguid, 1989). Cognition is socially and culturally constructed. This necessitates working collaboratively, highlighting contextualized authentic problems, and negotiating meaning (Owen, 2004). A situative perspective claims that how a person learns knowledge and skills and the situation where the learning takes place is an essential part of what is being learned (Borko, 2004; Putnam & Borko, 2000).

Borko (2004) states that a situative perspective of teacher learning is understood as teacher participation in the practice of teaching and therefore, because of this participation, teachers become more knowledgeable about the practice of teaching. The different aspects of practice where learning can occur are, for example, in teachers' classrooms, PD activities, school communities, and informal conversations with colleagues. To understand how teachers learn in these different situations, both the individual teacher learners involved in the activity and the social system in which they are participating in need to be examined. Multiple units of analysis are required to interpret a situative perspective. The key elements of a teacher PD system that are essential for interpretation using a situative perspective are the PD program; the teacher-learners in the system; the facilitator; and the context in which the PD occurs (Borko, 2004, p. 4).

Teacher Epistemology

Epistemology is the study of the nature, limits, and methods of acquiring knowledge (Kang & Wallace, 2005; Packer & Goicoechea, 2000; Schraw, Olafson, & VanderVeldt, 2011; Tsai et al., 2013). Epistemology is important for learning because it develops "epistemic

repertoires, or ways of knowing," (Tsai et al., 2013, p. 81) to assist learners in making sense of problems and challenges that a learner may encounter (Tsai et al., 2013). In recent years, education has been undergoing a constructivist reform where social constructivist epistemology has been influencing research and curriculum development (Brownlee et al., 2011; Howard et al., 2000; Kang & Wallace, 2005; Maor, 1999; Smith, 2013; Tsai et al., 2013; Yang et al., 2008). To meet the challenges of constructivist reform, teachers need learning experiences where they are actively involved in a process of meaning and knowledge construction, as opposed to passively receiving information, so as to modify their classroom practice and provide students with experiences that support constructivist epistemology (Howard et al., 2000; Kang & Wallace, 2005; Keiny, 1994; Luft & Roehrig, 2007; Maor, 1999; Marra & Palmer, 2011; Schraw, Brownlee, & Berthelsen, 2011)

Teacher epistemology is defined as teachers' beliefs about pedagogy, the nature of knowledge, and student learning (Brownlee et al., 2011; Luft & Roehrig, 2007; Maor, 1999; Yang et al., 2008). Studies have demonstrated that teacher epistemology can be resilient to change because of the strength of teachers' beliefs that shape their classroom practices (Brownlee et al., 2011; Howard et al., 2000; Luft & Roehrig, 2007; Maor, 1999; Prytula, Laurie-Ann, & McIntyre, 2010; Smith, 2013; Yang et al., 2008). Lortie (1975) explains that teachers have a tendency to rely on their memories of how they were taught in school. Traditionally, the epistemology of teaching and learning in education is the process of transmitting information (Brownlee et al., 2011; Prytula et al., 2010). Studies show that many teachers have a transmission-type epistemology that appears resistant to change in the classroom (Maor, 1999). This is possibly due to teachers' internal beliefs that have been created by their prior experiences

and knowledge as opposed to the habits and explicit behaviors of teachers (Jones & Carter, 2007; Prytula et al., 2010).

Howard et al. (2000) describe two types of teacher epistemologies: a transmissionist epistemology and a constructivist epistemology. A teacher who holds a transmissionist epistemology is one that believes knowledge is transmittable, unchanging, rapidly learned, innate, simple, and specific (Howard et al., 2000; Kang & Wallace, 2005; Schraw, Brownlee, & Berthelsen, 2011). Teachers who have transmissionist epistemological beliefs fail to see activities as meaning-making processes (Brownlee et al., 2011; Kang & Wallace, 2005). Whereas a teacher who has a constructivist epistemology holds that knowledge is complex, uncertain, learned gradually through a reasoning process, and is constructed by the learner (Howard et al., 2000; Kang & Wallace, 2005; Schraw, Brownlee, & Berthelsen, 2011).

Most researchers agree that teachers' epistemological beliefs and attitudes can influence the types of instructional practices that teachers choose to use in the classroom (Brownlee et al., 2011; Jones & Carter, 2007). This influence includes, among others, knowledge acquisition, instructional tasks, interpretation of course content, and choice of assessment (Jones & Carter, 2007). However, many teachers' beliefs are not always aligned with their practices (Feucht, 2011; Jones & Carter, 2007). Teachers' beliefs may be situated in the social norms of the school. Therefore some teachers may resist what they believe to be an important instructional practice because of the controversy and risk that the new practice may entail. Additionally, some teachers state the lack of resources for the new practice as a barrier to change. Possibly this perceived barrier to change is due to teachers' beliefs and may be removed if the belief system is changed. In one study, in-service teachers' entered a PD program with transmissionist beliefs and left the PD with many of their beliefs unchanged. Several of the teachers who participated in the PD

program did incorporate some of the new practices in their classrooms, although the strategies that they chose to use were those strategies that conflicted the least with their transmissionist belief systems. Notwithstanding, PD programs have been successful in getting teachers to assimilate new practices into their teaching, however, the programs did not have a corresponding change in teachers' beliefs (Jones & Carter, 2007).

Howard et al. (2000) found in their study of transforming teacher epistemologies that the "most powerful" (p. 461) influence for epistemological change was teachers working and collaborating with one another (Kang & Wallace, 2005; Maor, 1999; Prytula et al., 2010). Moreover, the researchers identified three strategies for epistemological change. The first strategy was to design opportunities for teachers to reflect on their implicit teaching beliefs (Howard et al., 2000; Kang & Wallace, 2005; Keiny, 1994; Maor, 1999; Schraw, Brownlee, & Berthelsen, 2011; Tsai et al., 2013; Yang et al., 2008). Teachers reflected on their teaching beliefs by writing, discussing, and participating in reflective activities (Howard et al., 2000). Reflection allows learners to turn strategies into meaningful pedagogic knowledge (Keiny, 1994; Prytula et al., 2010; Schraw, Olafson, & VanderVeldt, 2011; Schwartz & Jordan, 2011). The second strategy was challenging teachers' existing beliefs through both informal and formal feedback from peers and the trainer (Brownlee et al., 2011; Howard et al., 2000; Kang & Wallace, 2005; Keiny, 1994). Feedback is necessary so that teachers can think about their learning (Schwartz & Jordan, 2011). The third strategy was giving assistance and support to the accommodation of teachers' new beliefs (Howard et al., 2000; Keiny, 1994). The teacher learning community helps reduce teachers' cognitive dissonance when an approach contrasted with teachers' long-established teaching approaches (Howard et al., 2000; Kang & Wallace, 2005; Prytula et al., 2010). The researchers found that both content and context are essential

when designing a teacher-training program for promoting epistemological change (Feucht, 2011; Howard et al., 2000; Kang & Wallace, 2005). The teachers in the program "learned about constructivism by doing constructivism" (Howard et al., 2000, p. 461).

Problem-Based Learning

Problem-based learning (PBL) is an instructional approach to learning that is true to the central tenets of constructivism (Duffy & Cunningham, 1996; Gijselaers, 1996; Hmelo-Silver et al., 2007; Krajcik & Blumenfeld, 2006; Savery & Duffy, 1995) and is described by Savery and Duffy (1995) as "one of the best exemplars of a constructivist learning environment" (p. 1). PBL is learner-centered, active, and collaborative, and gives learners more responsibility and independence in their learning (Hmelo-Silver et al., 2007; Savery, 2006). Learners learn through problem-solving, self-directed inquiry, and reflecting on their experience (Hmelo-Silver et al., 2007). The teacher's (MKO/facilitator) role is to facilitate "collaborative knowledge construction" (Hmelo-Silver & Barrows, 2006, p. 21). The facilitator guides learners through the learning process, challenges learners to think critically, and models higher order thinking by asking the kinds of questions that learners need to be asking themselves (Duffy & Cunningham, 1996; Hmelo-Silver, 2003; Hmelo-Silver & Barrows, 2006; Savery & Duffy, 1995).

PBL is used in many medical schools as an instructional approach in medical education (Allen, Duch, & Groh, 1996; Duffy & Cunningham, 1996; Hmelo-Silver et al., 2007). The effectiveness of PBL in medical education as a model for learning (Albanese & Mitchell, 1993; Savery, 2006) has influenced educators in other fields of study to adopt a PBL model for their own contexts (Newman, 2003; Savery, 2006; Weizman et al., 2008). PBL has been used as an instructional method in the fields of nursing, engineering, science, economics, psychology, and occupational therapy, just to name a few (Newman, 2003; Savery, 2006; Weizman et al., 2008).

The PBL model engages learners in relevant real-world issues which research has shown to increase learner engagement (Allen et al., 1996; Krajcik & Blumenfeld, 2006; Loyens, Magda, & Rikers, 2008; Norman & Schmidt, 2000; Savery & Duffy, 1995). Additionally, learners who are engaged in the PBL process benefit from gains in the ability to think critically, analyze real-world problems, find, evaluate, and use information and resources, work cooperatively, learn to communicate effectively, and use content knowledge and intellectual skills to become lifelong learners (Duch, Groh, & Allen, 2001; Hmelo-Silver et al., 2007; Rué, Font, & Cebrián, 2013). Meta-analyses in the fields of medicine and education have provided some common characteristics of PBL (Albanese & Mitchell, 1993; Duch et al., 2001; Newman, 2003; Savery & Duffy, 1995). Savery (2006) developed a description of the common characteristics of PBL, which he based from his review of several meta-analyses on the impact and uses of PBL:

> 1) the role of the tutor (more capable other) as a facilitator of learning, 2) the responsibilities of the learners to be self-directed and self-regulated in their learning, and 3) the essential elements in the design of ill-structured instructional problems as the driving force for inquiry. (p. 15)

These common characteristics are fundamental to the effectiveness of PBL (Albanese & Mitchell, 1993; Hmelo-Silver & Barrows, 2006).

Hmelo-Silver (2004) describes the PBL cycle as the "PBL tutorial process" (p. 242) that involves six learning and problem-solving steps. During the cyclical PBL tutorial process, learners work in small collaborative groups of about five to eight people per group and a facilitator guides the group through a six-step PBL learning cycle (see Figure 1; Hmelo-Silver, 2004). A typical PBL tutorial process can last from one to four weeks (Lohman, 2002). First, learners are exposed to an authentic, meaningful, ill-structured problem. Ill-structured problems

are typical of problems regularly found in professional practice (Lohman, 2002). Hmelo-Silver (2004) defines ill-structured problems as those problems without a single correct solution and requires learners to examine other alternatives. Next, learners work together in their groups to identify the problem by analyzing and identifying the facts that are necessary for the learners to define what the problem is. Once the learners have identified the problem, they collaborate within their groups to generate hypotheses regarding the problem. Learners then collectively identify any knowledge deficiencies relative to the problem that they may have. Knowledge deficiencies (learning issues) are an important step of the PBL learning cycle since learners research their learning issues during their SDL. After learners have conducted their SDL research, they apply their new knowledge, evaluate, and revise their original hypotheses in consideration of what they have learned. This cyclical process continues until one or more solutions develop to create an appropriate conclusion to the problem. At the completion of a problem, learners deliberately reflect on the problem to abstract the new knowledge and skills they gained from the problem, how well that they collaborated with their group, and on their SDL strategies (Hmelo-Silver, 2004; Lohman, 2002; Loyens et al., 2008).

Self directed learning. SDL is an important feature of the PBL learning process (Hmelo-Silver, 2004). Knowles (1975) describes SDL as

> a process in which individuals take the initiative, with or without the assistance of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes. (p. 18)

Learners are responsible for their own learning during the PBL learning process. SDL requires learners to be self-reflective and think critically about what is being learned. This necessitates that learners use metacognitive strategies to develop their SDL skills.
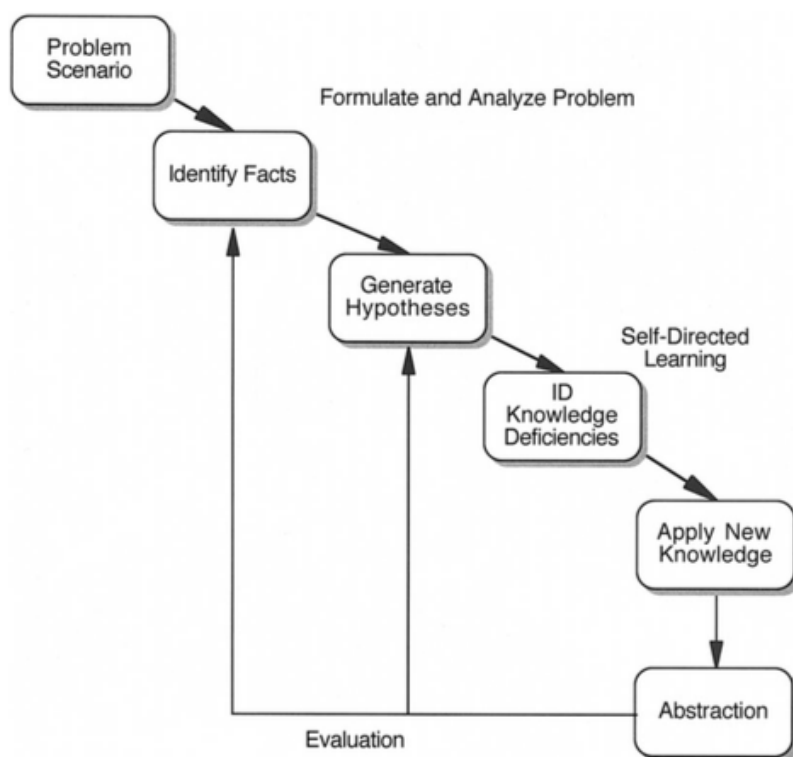
Figure 1. The PBL learning cycle. Reprinted from (Hmelo Silver, 2004, p. 237). Reprinted with permission.

Schraw (2001) distinguishes between two characteristics of metacognition: knowledge of cognition and regulation of cognition. Knowledge of cognition is defined as the awareness of and knowledge about one's own thinking. Regulation of cognition (metacognitive regulation) refers to a set of conditions that allows a learner to control his or her learning. Metacognitive regulation includes three essential skills: planning, monitoring, and evaluation. Planning involves the learner selecting appropriate strategies and allocating resources that affect the process of accomplishing an action, task, or function. Monitoring is the learner's ability to engage in periodic self-testing while learning. Through the process of self-monitoring, the learner may

discern the need for more study or the use of particular strategies. Evaluation refers to the learner's ability to evaluate the products and performance of one's learning. Re-evaluating one's goals and conclusions are some typical examples of evaluation (Schraw, 2001).

Self-reflection plays a crucial role in the construction of metacognitive knowledge and regulatory skills. Reflection is the ability of the learner to use the metacognitive knowledge that he or she obtained from previous learning experiences to devise viable action plans for the future. It is through the learner's reflections that the learner is able to gain insights into his or her learning performance (Ertmer & Newby, 1996; Schraw, 2001).

When the PBL learning process first takes place, activation of prior knowledge sets the stage for the to-be-learned information. Learners must be able to identify their knowledge deficiencies and set their own learning goals. Furthermore, learners need to plan their learning and choose relevant learning strategies. Lastly, learners must monitor and evaluate their learning and whether their learning goals have been achieved (Hmelo-Silver, 2004). Facilitators model SDL strategies (metacognitive strategies) and as learners become more responsible for their learning and as their SDL skills and strategies evolve the facilitator will fade his or her support (Hmelo-Silver, 2004; Loyens et al., 2008; Schraw, 2001).

The role of the facilitator. The foundation of PBL lies in the field of social constructivist theory (Hmelo-Silver & Barrows, 2006). Social constructivist theory supports learning where learners actively and collaboratively co-construct knowledge through social negotiation and where an MKO facilitates and guides the learners through the learning process (Duffy & Cunningham, 1996; Hmelo-Silver & Barrows, 2006; Tharp & Gallimore, 2002). In the PBL learning process, the MKO functions as a facilitator. The facilitator plays a pivotal role in the PBL learning process by establishing a culture where learners are expected to collaborate to

reach consensus, corroborate one another's ideas, and establish norms (Blumenfeld et al., 1991; Hmelo-Silver & Barrows, 2006). The role of the facilitator is to observe and check on the progress of the group's discussions and employ appropriate strategies according to the needs of the group (Hmelo-Silver & Barrows, 2006). Facilitators scaffold learners through the modeling of higher-order thinking by asking questions that explore learner's higher-order thinking. Facilitators avoid giving learners their opinions or information and keep their interactions with learners at a metacognitive level (Blumenfeld et al., 1991; Duffy & Cunningham, 1996; Hmelo-Silver & Barrows, 2006; Savery, 2006; Savery & Duffy, 1995). Additionally, facilitators challenge the learners' thinking to check for superficial and unclear thinking (Savery & Duffy, 1995). Moreover, he or she checks and challenges learners' understanding of the applicability and whether or not the learners have covered all the required characteristics of the issue (Duffy & Cunningham, 1996). Hmelo-Silver and Barrows (2006) describes the facilitator as an "expert learner, able to model good strategies for learning and thinking, rather than providing expertise in specific content" (p. 24). The facilitator progressively fades his or her support as learners grow more responsible for their learning and begin to adopt the questioning role (Hmelo-Silver & Barrows, 2006). This is in accordance with Stage 3 of Tharp and Gallimore's (2002) four-stage model of ZPD where performance becomes internalized and automized, and the MKO is no longer needed. The learner emerges from the ZPD to manage the task at hand (Tharp & Gallimore, 2002).

Reflection. Dewey argues that true learning occurs only after a learner has reflected on his or her learning experiences (Rodgers, 2002). Maor (1999) describes reflection as individual learning that involves some form of social learning. One of the essential objectives of PBL is to encourage reflection (Hmelo-Silver, 2004; Rué et al., 2013; Yuen Lie Lim, 2011). In a PBL

environment, learners work through meaningful, ill-structured problems and must use reflective reasoning as a means to construct their own understandings (Hmelo-Silver, 2004; Yuen Lie Lim, 2011). Reflection involves a reevaluation of beliefs in view of the problem or situation. When learners are engaged in reflection they not only evaluate their learning experiences for various solutions to the problem but also their actions for future improvements (Yuen Lie Lim, 2011). Critical reflection occurs when learners identify, analyze, and assess the soundness of their assumptions and beliefs, and then transform these assumptions to guide the learner's future actions and practices (Yuen Lie Lim, 2011).

Hmelo-Silver (2004) details how reflection is integrated several times throughout the PBL process and when finalizing the problem. Once the problem is finalized, learners reflect on what they have learned, their contributions to the group, and their SDL skills (Hmelo-Silver, 2004). The PBL environment is designed to help learners transfer their problem-solving strategies, SDL strategies, and knowledge to new settings. Reflection is critical for learners in a PBL environment so that learners do not only emerge from the learning experience with information but with knowledge that will transform their "thinking, actions and practice" (Yuen Lie Lim, 2011, p. 172).

Problem-Based Learning Professional Development

PBL has several advantages as an approach to PD. PBL is a way of constructing programs and courses using authentic ill-structured problems as the stimulus and focus for participant activity (Mulford et al., 2004). It is an instructional method that structures knowledge around problems rather than a field of study (Mulford et al., 2004). PBL is learner-driven yet it is facilitated. Participants not only develop their own meaningful ill-structured problems that guide their research but in addition, the PBL process accommodates participants' learning levels and

needs (McConnell et al., 2013; Zhang et al., 2011). Very few studies are currently available on the use of PBL as a PD model for teachers; however, the few that are available show that PBL has a large positive effect on supporting teacher learning (McConnell et al., 2008; McConnell et al., 2013; Zhang et al., 2011).

McConnell et al. (2013) conducted a study on PBL as an approach to designing teacher PD that meets the needs of a diverse population of teachers. Teachers who participated in the PBL PD program entered the program with varying ranges of content knowledge. The researchers found that the PBL PD advanced teachers' content understanding with 80% of the 41 teachers who participated in the PBL PD demonstrating gains in their content knowledge, and 59% of teachers labeled as having high incoming knowledge still improving on their post-assessment responses (McConnell et al., 2013).

Problem-solving is an important feature of professional practice. Professionals depend on their skills to manage the ill-structured problems that can arise as a part of their profession (Brownlee et al., 2011; Lohman, 2002). It is critical that organizations sponsor programs to develop the problem-solving skills of their professional personnel (Lohman, 2002). Lohman (2002) conducted an extensive literature review on four problem-based approaches to PD: case study, goal-based scenario, problem-based learning, and action learning. She found that the PBL PD approach results in "double-loop" (p. 255) learning. Double-loop learning is the "critical examination of a problem's underlying assumptions, procedures, and goals" (p. 255). In addition, Lohman (2002) characterized PBL PD learner outcomes as a transfer of content knowledge and developing the skills and ability to solve ill-structured problems. Moreover, PBL results in the development of schemata. The PBL process supports learners developing a "hypothetico-deductive reasoning" (p. 255) which, in turn, helps learners develop schemata for problem-

solving. As learners develop schemata for problem-solving they are able to more quickly identify problems and implement strategies to solutions. Lohman (2002) determined that the PBL PD approach is an effective approach to implement when the objective of the organization is to solve ill-structured problems. She concludes that problem-based approaches to PD show great promise for promoting the problem-solving skills of professionals in today's workplace (Lohman, 2002).

Zhang et al. (2008) analyzed teachers' motivation to reenroll in a PBL PD project. The five year National Science Foundation (NSF) funded research project, "Problem-Based Learning Project for Teachers," was composed of summer and year-long components. Teachers' decisions to reenroll in PD programs that are not required are dependent on teacher motivation. The researchers found that teachers did reenroll in the PBL PD program when the participants considered the utility value essential. Based on the theory of the utility value of tasks, teachers may lack the motivation to attend PD activities because it is seen as far removed from their instructional practices. Teachers expect to change their practice when they attend PD programs, however; administrators and policy makers, as opposed to teachers, usually drive the types of knowledge and skills learned in PD programs. The utility value of a PD program needs to be perceived by teachers as valuable and beneficial to their teaching practice. The participants in the study willingly gave up their free time to participate in the PBL program because the program benefits (resources, expert support, content and pedagogical knowledge, and creating unit plans) outweighed the costs (of not getting to spend time with family or not work out). Teacher participants appreciated selecting their own learning issues, which in turn enhanced teachers' intrinsic motivation. The researchers state that, based on the utility value, PD learning tasks should have a firm link to teachers' work contexts (Zhang et al., 2008).

The researchers also found that teacher participants were motivated by incentives to enroll in the program. The researchers state that this is consistent with other findings in studies of teacher incentives. They claim that to develop an appealing PD program for teachers, the PD program should not only be tied to teachers' work contexts but should also provide some teacher incentives. Although the teacher participants in the study appreciated the role of incentives, they expressed that their actual learning was more valuable. Therefore, the researchers assert that incentives are important to initially attract teachers to enroll, however; re-enrollment relies more on teachers' intrinsic motivation to learn (Zhang et al., 2008).

In addition, the researchers found that social interactions and an encouraging school culture were important to the teacher participants. Teachers were pulled back to the program because they valued the support they received from their principal, peers, and extended learning communities. The researchers maintain that PD programs are more effective when teachers participate with colleagues from their individual school sites and receive social help in the form of sharing, collaboration, and emotional support from their peers and facilitators (Zhang et al., 2008).

When designing a PD program for teachers, the researchers recommend flexibility in encouraging teachers to select their own learning issues and that the PD program outcomes outweigh the costs (time commitment) of the program. Enrolling in an extended program requires that teachers are motivated to participate. Teacher participants were intrinsically motivated to participate in the PBL PD program when they felt supported by an encouraging school culture where the principal, teachers, and learning community encourages teacher learning (Zhang et al., 2008).

McConnell et al. (2013) developed a teacher PD program where each stage of the PD program was organized using a PBL framework to guide teachers' thinking and learning. The purpose of the PBL PD was to provide teachers with a framework for analyzing their practice with the objective of bettering their science teaching. The researchers found that one of the significant outcomes of the PBL PD program was that teachers began to use PBL as a means for examining and revising their science teaching. Moreover, teachers started to use the PBL framework to analyze their teaching practice in other subject areas also. Using PBL as an analytical framework helped the teachers in the program make evidence-based decisions about effective teaching strategies. In addition, by partaking in the PBL PD teachers gained a deeper understanding of science content knowledge, while simultaneously developing their critical thinking skills. The researchers claim that using PBL as an approach to PD provides a framework that is valuable for teachers to use for reflection and analysis of their teaching practices in an ongoing process of professional learning.

Summary

Research supports the need for a more beneficial and effective PD for teachers. The characteristics of effective PD that strengthens teacher practice and fosters improvements in the classroom is PD that promotes active learning, emphasizes collaboration, is sustained over time, is correlated to teachers' specific contexts and curriculum, and is coherent with the school as a whole.

The features that research claims are effective for teacher learning are characteristic of a constructivist learning environment. The constructivist principles that guide learning are learners need to examine thinking, construct their own meaning, reflect on previous understandings, actively participate, question, solve problems, and collaborate with others. The facilitator's role

in a constructivist learning environment is to model metacognitive thinking related to the problem-solving process. Vygotsky (1978) placed emphasis on the understanding that learning is social in origin. He claimed that learning is not only reliant on prior experience, but it is also reliant on the ability to learn with the help of others.

Vygotsky's theory on the ZPD has provided an understanding of learning and has influenced instruction in education. Tharp and Gallimore (2002) make the claim that Vygotsky's theory on the ZPD is applicable for people of all ages. They describe the ZPD as a four-stage process of learning and they use this process to describe teacher learning. The researchers state that the mark of an excellent school is an organizational structure for affording teachers the opportunities to develop their expertise and skills with the recurring assistance of others.

PBL is an instructional approach to learning that is true to the central tenets of constructivism. PBL can be used to structure effective teacher development. The adaption of PBL from other fields of expertise to teacher PD is only starting to be developed and therefore only a few results of systematic empirical research are available (see above). Nevertheless, the results from these studies indicate great promise (McConnell et al., 2008; Mulford et al., 2004; Zhang et al., 2011). PBL PD incorporates all of the elements that research has identified to universally increase the likelihood for effective teacher development. Based on the goals, constructivist principles, explanations for use, and evidence of benefits, PBL is a high quality, effective and productive approach to teacher PD as a means for promoting active inquiry, acquiring problem-solving skills, training teachers to be reflective, cultivating SDL, emphasizing collaboration and communication skills, sustaining teacher learning, and integrating knowledge with practice.

Chapter Three: Research Methods

Introduction

  This study was designed using a multi-case study approach (Yin, 2014). Yin (2014) defines the case study research method "as an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used" (Yin, 2014, p. 16). Yin (2014) states that the analytic benefits of multi-case (two or more cases) designs are substantial and therefore preferable over single-case studies. A multi-case study was chosen over a single-case study because evidence from a multi-case study is considered strong and reliable (Baxter & Jack, 2008). The research questions that direct the study, sampling, setting and participant description, data collection, procedures and measures, data analysis, and limitations are presented in this chapter. Since this study involves direct interactions with people, it also is necessary to include a discussion of the ethical protection of the participants (Creswell, 2009, 2013).

  Purpose of the study. The purpose of this multi-case study was to investigate how problem-based learning can be used as an approach to teacher learning for K-5 teachers at XYZ School. A secondary purpose of this study was to start to investigate how teachers' personal epistemologies may be interrelated to how teachers make sense of a PBL PD approach to teacher learning. Each participating teacher was considered a case. In this study, data was collected by means of teacher interviews, teacher belief vignettes, a teacher beliefs questionnaire, and audio

recordings of the PBL meetings and interviews. The first two questions are central to the primary purpose of this study. Question 3 relates to the secondary purpose of this study:

1. What kinds of supports do teachers need during the PBL PD sessions? How does that scaffolding change over the course of the implementation?

2. Which components of the PBL PD model do teachers identify as most effective/ineffective (important) for improving their skills and/or practice?

3. How do teachers' personal epistemologies relate to how they participate in a PBL PD approach to teacher learning? Do teachers show any changes in their epistemologies from the beginning to the end of the experience?

Based on the review of the literature on effective teacher PD, this researcher structured the PD to model a PBL approach to teacher learning. There is not much literature to guide the PBL PD, so the researcher documented what worked and did not work for this group of teachers. Since teachers' epistemological beliefs are related to how teachers teach (Brownlee et al., 2011; Jones & Carter, 2007), this new way of doing PD may have had some effect on their epistemological beliefs.

Research Design

The research design for this study is a multi-case study approach based upon the characteristics defined by Yin (2014). A case study is a type of research inquiry where the researcher examines in-depth a program, event, activity, or process over a period of time (Yin, 2014). When the case study approach is put to practical use, it becomes a valuable method to develop theory, evaluate programs, and develop interventions (Baxter & Jack, 2008). This approach is based on a constructivist paradigm (Baxter & Jack, 2008). Constructivism is built upon the premise that learning is a socially constructed process. Constructivists assert that truth

is relative and that it is dependent on a person's point of view. Therefore, a constructivist approach to research design allows the researcher to collaborate closely with participants. This close collaboration enables participants to tell their stories and describe their views of reality, which makes it possible for the researcher to better understand the participants' actions (Baxter & Jack, 2008). However, the researcher must also seek to remain unbiased and subjective throughout the data collection process (Yin, 2014).

Case study research is appropriate to use when the researcher wants to understand a distinctive situation where the boundaries are not clear between the phenomenon and the context (Baxter & Jack, 2008). The researcher collects evidence using data sources such as observations, interviews, archival records, documentation, and physical artifacts, and converges the data in a triangulating fashion (Baxter & Jack, 2008; Creswell, 2013; Yin, 2014). To ensure a more holistic approach to the phenomenon being studied, investigators can also collect and integrate quantitative survey data (Baxter & Jack, 2008; Creswell, 2013; Yin, 2014). The purpose of using both qualitative and quantitative data is to not only provide rigor but to also contribute a richer understanding of the case (Baxter & Jack, 2008; Yin, 2014).

Merriam (2009) asserts that the strengths of a case study approach far outweigh the limitations. She explains that case study is especially useful for studying educational innovations, evaluating programs, and informing policy. In addition, she describes how the insights gleaned from case study can play an important role in adding to a field's knowledge base. However, there are limitations also. One concern Merriam (2009) outlines is the possibility of an unethical case writer. An unethical case writer can purposefully select anything that he or she wants to illustrate and, therefore, the final product may be biased. However, research aims should drive methodological choices. The advantage of case study is it results in an in-depth, empirically rich,

and holistic account of a phenomenon. These insights can be translated into a developing

hypothesis, which can aid and help structure future research (Merriam, 2009).

This researcher used a multi-case study design (Yin, 2014) to explore in-depth the

phenomenon of how PBL as an approach to teacher learning can be used to develop effective PD

at XYZ Elementary School. "Multiple-case design, or collective case design" (Chmiliar, 2010, p.

583) is case study research where several cases are selected to develop a more in-depth

understanding of the situation than a single case can provide (Chmiliar, 2010). This study

followed several stages. The first was that each case was treated separately. All the data within

the case was examined as a unique, holistic entity. Once each case was developed and themes

identified, cross-case comparisons were made. The data across the cases was analyzed to identify

characteristics that were common and also different. (Chmiliar, 2010). In this research, each

teacher was considered a case, rather than the school as one case. This decision was made since

one research question focused on understanding how teachers' epistemological beliefs may

mediate their perceptions of the PBL PD. Investigating how a PBL constructivist approach to PD

impacts teacher epistemology may help to develop effective PD for XYZ Elementary School and

will hopefully provide insight for others interested in PBL PD. Multiple cases presented different

teachers perspectives and began to show the influence of personal epistemology on teachers as

they learn.

Assumptions

An assumption is a statement(s) that the researcher holds to be true before he or she

begins the study and from which the researcher may draw some conclusions. Bloomberg and

Volpe (2012) state that qualitative researchers should identify four to five assumptions based on

the important issues discussed in the study. Toward the end of the analysis of the data, the

researcher revisits his or her assumptions. The researcher may find that his or her assumptions may or may not be justified and reflects upon these assumptions.

The researcher made some assumptions before the project started. The assumptions were based on her past experiences and relationships with the teachers at XYZ Elementary School. This researcher's first assumption was that the teachers will find the PBL PD collaboration time meaningful and beneficial to their professional learning. This assumption was guided by social constructivist theory where the emphasis is on the collaborative nature of learning. Additionally, this researcher inferred that the teachers will already have competence for collaboration since the teachers at XYZ Elementary School are expected to collaborate and time is built into the school schedule to accommodate grade level collaboration. Second, teachers at first needed to rely heavily on the facilitator for guidance. This assumption was based on the premise of Vygotsky's theory of the ZPD, that what learners can do and learn with the support of others exceeds what they can do on their own. Teachers at XYZ Elementary School, for the most part, have engaged in a transmissionist style of PD. They will need support and assistance from the facilitator to adapt to this new constructivist approach to their professional learning. Third, this researcher believed that teachers may struggle with the idea of having to spend some personal time outside the duty day for SDL. This assumption was based on the experience that this researcher has had in the past with some teachers expressing dissatisfaction of giving more time to their school than their paid hours. In past years, the school district tried to offset this disparity by offering financial incentives for teachers to learn over and above the duty day. Fourth, this researcher assumed that a PBL approach to PD will be a useful and effective means for teacher learning. This assumption was based on the research that states effective PD promotes active learning, emphasizes collaboration, is sustained over time, is correlated to teachers' specific contexts and curriculum,

and is coherent with the school as a whole. All of these elements are aligned with a constructivist approach to learning. PBL is an approach to learning that is true to the central tenets of constructivism (Savery & Duffy, 1995). Therefore, the researcher assumed that a PBL approach to teacher PD will be a useful and effective means for XYZ teachers' professional learning experiences. Fifth and finally, the researcher will not tell teacher participants what their worldviews are to guard against teachers believing one worldview is better than another and biasing their responses. This researcher has her worldview that is constructivist, but she will not share her worldview with the teachers nor react to their worldviews.

After the project, the researcher found that her assumptions, for the most part, were correct. The teachers never complained about participating in the PBL meetings. They all stayed for the length of the meetings (one hour) and never tried to not show up or participate. Teachers also spent time outside of their duty day to examine and think about resources that we could use to answer the groups' driving question. The district did offer financial support for those PBL PD meetings that went past the duty day; however, most of the PBL PD meetings were typically during the duty day. This researcher's assumption that the teachers would rely heavily on the facilitator did not hold true. Teachers mainly relied on one another for assistance, especially when the assistance aligned with a teacher's epistemology (see Chapter Four). The assumption that a PBL approach to PD will be a useful and effective means for teacher learning is mostly true when practiced under certain conditions (See Chapters Four and Five).

The Role of the Researcher

The role of the researcher in this case study was that of an insider-researcher (Unluer, 2012). An insider-researcher is a researcher who studies a group to which he or she belongs (Unluer, 2012). Unluer (2012) describes three advantages to being an insider-researcher: has a

better understanding of the culture under study, will not interrupt the flow of social interaction where it may artificially change its course, and will have established relationships with participants that facilitates the telling and judging of the truth. Additionally, the insider-researcher understands how to best approach the participants in the study as opposed to an outsider. The problem associated with being an insider researcher is the possible loss of objectivity. Biases may occur because of greater familiarity with participants and the situation. However, all the participants, including the researcher, brought diversified perspectives to the situation, which created a more "balanced" (Unluer, 2012, p. 2) and "objectivist" (Unluer, 2012, p. 2) account of the case under study.

As an insider-researcher, this researcher had a role duality, researcher and facilitator. This researcher's role was that of the facilitator of the group and also the data gathering instrument. The data included audio recordings of the PBL PD meetings, interviews with the participants, and a questionnaire. Researcher biases may have arisen as this researcher collected and analyzed the data. However, biases were minimized by the researcher through her use of a reflexive bracketing journal and her consistent use of interview protocols.

The researcher sought to collect the data with a minimal amount of prejudice. This required an awareness of the researcher on the effects of bias on data collection and analysis (Unluer, 2012). The researcher sincerely attempted to bracket her experiences while conducting participant interviews and observations in order to lessen the impact of personal bias (Merriam, 2009). Bracketing is where the researcher seeks to set aside his or her experiences to undertake a fresh perspective toward the phenomenon under study (Creswell, 2013). In order to make non-biased decisions or conclusions, the researcher bracketed her thoughts, feelings, and experiences. This researcher used a self-reflective journal as a tool for bracketing. The self-reflective journal

was used to examine this researcher's assumptions and goals (Ahern, 1999). Reflexive journaling also aided this researcher in not allowing her assumptions to shape the data collection process. This researcher minimized her biases by clarifying the research process and being aware of her role as a researcher (Unluer, 2012).

PBL PD Meetings

The PBL PD structure was based on Hmelo-Silver's (2004) "The PBL Learning Cycle" (see Figure 1). PBL PD can be structured so that it is divided into a number of phases to support teacher learning (Miao, Holst, Haake, & Steinmetz, 2002). The PBL PD learning cycle (Figure 2) was broken down into seven phases. The PBL protocols were designed as a script for the facilitator (this researcher) to use to support the PBL approach to PD. Each phase varied in length depending on the phase of the learning process. As teachers gathered new information they worked recursively through the PBL PD learning cycle.

A protocol is useful for recording observational data such as descriptions of the setting, depictions of the participants, demographics, accounts of events, and the researcher's reflections (Creswell, 2009). Additionally, protocols can be used as a script that describes the typical course of events (Miao et al., 2002).

The facilitator used two protocols for the PBL meetings. The protocol for the first PBL meeting (Appendix A) was structured to address phases one through four of the PBL PD learning cycle. This protocol was used once. The second protocol (Appendix B) was used for the first few PBL PD meetings. After the first few meetings the researcher opened the PBL PD meetings with an open huddle and then worked recursively thought the other steps verbally without the meeting protocol in front of her.
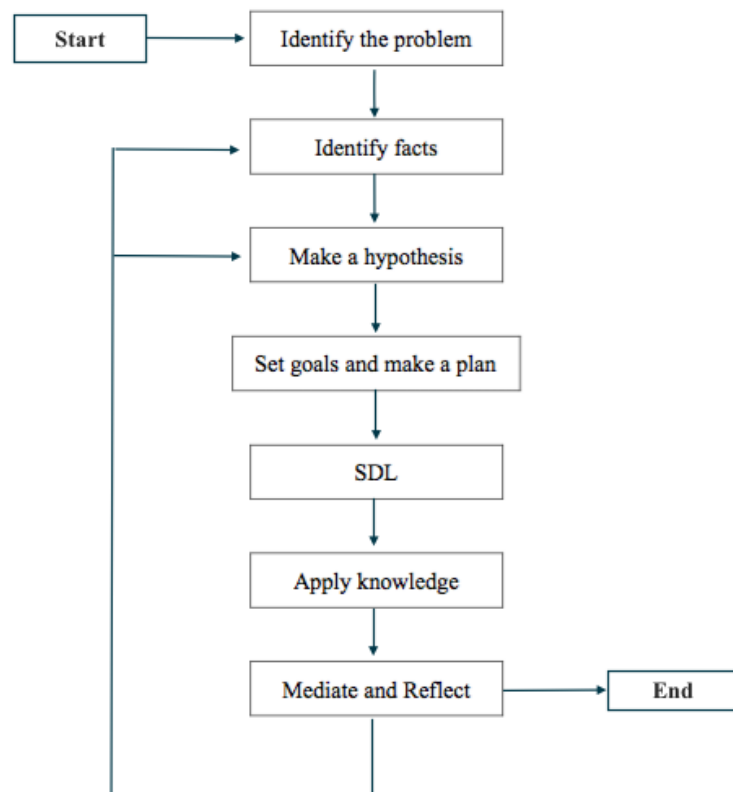
Figure 2. PBL PD learning cycle adapted from Hmelo-Silver's "PBL Learning Cycle" (2004).

The PBL meetings were held over the course of eight months from September 2015 through April 2016. These meetings took place in a teacher's classroom located on the school site. PBL meetings were scheduled by the teachers and the facilitator during the "Set goals and make a plan" phase (see Appendix B). These meetings were audio recorded and later transcribed. Each meeting, except for the first PBL PD meeting, followed the PBL PD meeting format (see Appendix B). See Table 1 for the PBL PD timeline.

To determine trustworthiness of the PBL PD meetings, the same procedures were used for every meeting, except for the first meeting (Appendix C). The PBL meeting protocol was easy to follow and the method is easy to replicate. Additionally, the audio recordings of the interviews were examined carefully to analyze this researcher's actions. One example of a

question that this researcher will ask is, "Did I influence or lead the participants in any way?" Continuous reflections by the researcher will help ensure the trustworthiness of the data analysis.

Source of Data

The primary source of data for this study were the meetings of the three fifth-grade teachers and the facilitators at XYZ Elementary School.

Setting. The research site for this multi-case study was a public school, XYZ Elementary School, located in an affluent community in Santa Clara County, California. XYZ Elementary School is a lottery school-of-choice that provides a traditional philosophy of education and environment. XYZ Elementary School is not a neighborhood school as students can come to XYZ Elementary School from any neighborhood within the school district. With its "Back to Basics" philosophy and high expectations for behavior and responsibility XYZ Elementary School has long waiting lists for student enrollment. XYZ Elementary School has consistently been recognized for student academic excellence (Blue Ribbon).

During the 2015/2016 XYZ Elementary School year, there were approximately 699 students in kindergarten through fifth grade. In 2015/2016 the faculty population consisted of 29 certified personnel staff, which included one principal and one assistant principal.

The interviews, teacher belief vignettes, teacher beliefs questionnaire, and PBL PD meetings were conducted at the XYZ Elementary School site. The PBL PD took place in a teacher's classroom located on the school site. The interviews were conducted in person and were held in each teacher's respective classrooms behind closed doors, thus ensuring the confidentiality of the teacher participants' responses.

Population, sample, and sampling procedures. The sample included three teachers from XYZ Elementary School. The teacher participants who were selected for this study were

from the same grade level. The purpose of choosing teachers from the same grade level is that XYZ Elementary School sets aside specific times for grade level collaboration. Also, each grade level conducts activities that are unique to that specific grade level. It would have been too difficult to plan a PBL PD with teachers from different grade levels, each with different grade level activities.

All participants who were selected for this study resided in Santa Clara County, California. Convenience sampling was used because this researcher taught at the research site and the participants were readily available. Despite the fact that convenience sampling is the least credible of all the sampling strategies, it serves sites or individuals so that the researcher can handily access and collect data (Creswell, 2009; Yin, 2014). All participants were voluntary and received informed consent (Appendix D), in line with Pepperdine's IRB ethical standards. Participation in this research study was strictly voluntary.

During a school leadership meeting, the researcher explained the purpose of this research study and requested volunteers from the same grade level for this study. The researcher did not use any coercive efforts to influence individual participation and made it clear that participation in the study was voluntary. The researcher did not pose any threat nor harm to the research site or any of the participants who were involved in this study.

Data Collection Procedures

This multi-case study examined a group of three teachers in the naturalistic setting of XYZ School. The primary methodology that was used was multi-case study. Data were collected for eight months before, during, and after the PBL PD (see Table 1), including teacher interviews, teacher belief vignettes, and a teacher's beliefs questionnaire. Additionally, data was collected through the PBL PD meetings. A face-to-face interview method was used for the

individual semi-structured interviews before and after the entire PBL PD. The teacher belief

vignettes (Appendix A) were introduced to the participants during the individual interviews so

that they could comment on their answers. Each participant was asked to read the vignette

summary and rate each worldview on a 5-point scale ranging from strongly agree to strongly

disagree (Schraw & Olafson, 2003). The pre and post PD interview protocols for the proposed

study were designed to address research questions and teachers' epistemological beliefs.

Creswell (2013) states that an interview protocol should contain around five to seven open-ended

questions that are based on the questions in the study but translated to a format that the

interviewee can understand and answer.

Table 1

PBL PD Timeline for Data Collection and Meetings

Data	Date
General introduction to PBL	September 8th, 2015
Passed out the consent form	September 8th, 2015
Pre-PBL PD Teacher Interview Pre-Interview Protocol Teacher Belief Vignettes	September 2015
First PBL Meeting. Discussed and planned for future PBL meeting times	September 18th, 2015
PBL meeting protocols PBL meeting audio recordings	September 2015 – April 2016
Post-PBL PD Teacher Interview Post-Interview Protocol Teacher Belief Vignettes Teacher Beliefs Questionnaire	Conducted after the last PBL PD, April 2016

A protocol is useful for recording observational data and can be used as a script that

describes the typical course of events (Miao et al., 2002). Creswell's (2013) interview protocol

(Appendices A and D), was used to collect interview data before and after the PBL PD. Interviews were audio recorded. Schraw and Olafson's (2002) Adapted World View Vignettes (Appendix A) were used along with the interview protocols. Additionally, the PBL meetings followed a protocol (Appendices E and F). All interviews and the eight PBL meetings were audio recorded.

Introductions and documentation. In September 2016, prior to the PBL PD, the researcher met with the fifth-grade teachers to provide a general introduction to the PBL PD. At the end of the introductory meeting, teachers were given an informed consent form (Appendix D). Each participating teacher was asked to place his or her signed consent form in a manila envelope and place the sealed manila envelope in the researcher's mailbox located on the school site. The researcher provided teachers with manila envelopes.

Pre-PBL PD interview. Interviews are guided conversations that are usually one of the most important sources of case study evidence (Yin, 2014). The pre-PBL PD interview occurred in September 2015 and was focused on general information about the teacher, including teaching experience, educational background, and epistemological beliefs. Teacher belief vignettes (Appendix A) were also introduced so teachers can comment on their answers. Interviews were semi-structured, following a general script (Appendix G) based on the research questions and teacher velief vignettes, but allowed for exploratory questions depending on teacher responses. The pre-PBL interview was designed to address research questions and teachers' epistemological beliefs. Creswell (2013) states that an interview protocol should contain around five to seven open-ended questions that are based on the questions in the study but translated to a format that the interviewee can understand and answer. Creswell's (2013) interview protocol (Appendix G)

was used to collect interview data. Interviews were audio recorded. Interviews were conducted at XYZ Elementary School outside of the school day in each teacher's respective classroom.

The use of an interview protocol positively contributes toward the reliability of the case study (Baskarada, 2014). To ensure the trustworthiness of the pre-PBL interviews, the same interview protocol (Appendix G) was used for each participant. Additionally, the researcher used member checking to increase the validity and the credibility of this study by questioning the participant to determine accuracy during the pre-PBL interviews. Audio recordings were analyzed to assess this researcher's possible actions or biases during the interviews. For example, a question that was considered was whether I led or manipulated the participant. Such reflection ensured the trustworthiness of the data analysis.

Post-PBL PD teacher interview. The researcher interviewed each teacher at the completion of the PBL PD in April 2016. The purpose of these semi-structured interviews (Appendix H) was to determine what the teachers found effective and/or ineffective about the PBL PD and to evaluate via the Teacher Belief Vignette (Appendix A) how and why teachers' epistemological beliefs about teaching and learning may have changed. The post-PBL interview was designed to address this study's research questions and teachers' epistemological beliefs. Creswell's (2013) interview protocol (Appendix H) was used to collect interview data. The post-PBL interviews were audio recorded. Interviews were conducted at XYZ Elementary School outside of the school day in each teacher's respective classroom.

To ensure the trustworthiness of the post-PBL interviews, the same interview protocol (Appendix H) was used for each participant. To increase the validity and the credibility of this study, this researcher used member checking by questioning the participant to determine accuracy during the post-PBL interviews. Additionally, the audio recordings of the interviews

were examined carefully and the researcher's reflections of the data ensured the trustworthiness of the data analysis.

At the end of the post-PBL interviews the researcher handed each participant the Johnston, Woodside-Jiron, and Day's (2001) Adapted Teacher's Beliefs Questionnaire (Appendix I) to complete. Each participating teacher was asked to place his or her completed Adapted Teacher's Beliefs Questionnaire in a manila envelope and place the sealed manila envelope in the researcher's mailbox located on the school site. The researcher provided teachers with manila envelopes.

Schraw and Olafson's (2002) adapted world view vignettes. Vignettes can be used in conjunction with interviews and questionnaires to determine epistemological worldviews and to stimulate reflection (Schraw, 2013). Each participant was asked to read the vignette summary for the realist, contextualist, and relativist view (Schraw, 2013; Schraw & Olafson, 2003) and rate each worldview on which they agreed on a 5-point scale ranging from strongly agree to strongly disagree (see Appendix A) to determine the level of agreement of the three worldviews. The epistemological worldview summaries were designed to elicit beliefs about knowledge and the extent to which teacher participants agreed with each worldview (Schraw & Olafson, 2003). A realist worldview is associated with transmissionist beliefs about knowledge, while contextualist and relativist worldviews are associated with more constructivist beliefs. This adapted instrument (Schraw & Olafson, 2003) was introduced to the participants during the pre and post interviews so that the participants could comment on their answers. The purpose of this instrument was to provide participants with a concrete format to talk about their own epistemological beliefs. Each of the three worldviews is labeled vignette 1, 2, and 3 to avoid biasing teachers' ratings (see Appendix A). The same vignette summary (Appendix A) was used for each participant. Member

checking was conducted by questioning the participant to determine the accuracy of statements. Since the vignette summary was introduced during the pre and post PBL interviews, responses by participants were audio recorded and analyzed by the researcher to ensure the trustworthiness of the data analysis.

A case for strong construct validity can be determined when a researcher chooses several similar constructs. Positive correlations are associated with similar constructs and constitute convergent validity evidence (Schraw & Olafson, 2008). Support for the vignettes was obtained since this researcher also used another measure of epistemological beliefs adapted from Johnston et al.'s (2001) "Identifying Features of Epistemological Stances" Questionnaire (see below for more information).

Adapted teacher's beliefs questionnaire. A teacher beliefs questionnaire (Appendix I) was administered prior to participating teachers engaging in the PBL PD as a means of determining general beliefs about the nature of knowledge. The 8-item instrument sought to measure teachers' epistemological beliefs on a continuum from more transmissionist (objectivist/received) to more constructivist. The questions were adapted from Johnston et al.'s (2001) "Identifying Features of Epistemological Stances" (p. 7). Each question was developed from either the *Received Knowing* or the *Constructed Knowing* characteristics. Participants read a statement and then indicated their level of agreement using a Likert-type scale from 1 (strongly agree) to 5 (strongly disagree). Sample questions are displayed in Table 2.

Half of the items on the questionnaire were written so that teacher participants with a transmissionist epistemology would agree with the statements. The other questions were written so that teacher participants with a constructivist epistemology would agree. The transmissionist epistemology items were reversed coded before analysis. A composite score was computed by

summing the 8 responses. Scores ranged from 8 to 40 with the lower scores indicating a

transmissionist epistemology and higher scores indicating a constructivist epistemology.

Table 2

Sample Items from Teacher's Beliefs Questionnaire

Epistemological Stance	Sample Items	Likert Scale
Received Knowing	Controversial issues should be avoided in the classroom setting.	1 2 3 4 5
Constructed Knowing	I believe students learn much better in groups than by working individually.	1 2 3 4 5

Johnston et al.'s (2001) "Identifying Features of Epistemological Stances" was used to

guide the development of questionnaire items for the "Johnston et al.'s (2001) Adapted

Teacher's Beliefs Questionnaire." Face validity was used to help establish content validity for

this instrument. Face validity requires looking at the questionnaire items and using subjective

judgment to determine whether a test appears to measure the targeted research question of the

study (Rattray & Jones, 2007). The researcher's evaluation of the items to the features of the

epistemological stances provided a look at the content validity of the questionnaire. The items

were also reviewed by the researcher's dissertation advisor and revisions were made to improve

both clarity and readability of the items, which assisted in ensuring content validity (Rattray &

Jones, 2007). To further ensure content validity, this researcher asked three experts in the field of

social constructivism to aid in determining whether the scale items represented what this

questionnaire was intending to measure (Rattray & Jones, 2007). The three experts' comments

were analyzed using content analysis. Modifications to the questionnaire were made according to

the experts' responses. The questions that were developed are appropriate considering the

purpose of the study and the targeted research question, Do teachers' personal epistemologies affect their perceptions of a PBL PD approach to teacher learning?

Audio recordings. Audio recordings are useful as a tool for data collection. The use of audio recordings is often considered more rigorous than the use of field notes since audio recordings can provide a more accurate and comprehensive representation of "what happened" (Hammersley, 2010, p. 3). Many researchers prefer electronic recordings to field notes because the data can be preserved and reproduced (Bloor & Wood, 2006; Hammersley, 2010). Audio recordings are also valued for their detailed record of exact speech (Bloor & Wood, 2006; Tessier, 2012). In addition, audio recordings allow for the repeated revisiting of the data to check for emerging themes (Bloor & Wood, 2006; Hammersley, 2010; Tessier, 2012). Bloor and Wood (2006) in their book, *Keywords in Qualitative Methods,* state that audio recordings are beneficial because they give researchers opportunities to reflect on their interviewing techniques. They explain that the advantages of using audio recorders are that they free the researcher from taking notes so that he or she can focus on the discussion at hand and prompt participants for additional responses. Moreover, audio recording improves the reliability of the data collection since the data is not reliant on the researcher's selective memory (Bloor & Wood, 2006; Tessier, 2012)

Some researchers believe that a participant's awareness of electronic recordings for observation may affect the participant's behavior. If a participant's behavior is affected this could impact the internal validity of the study (Jewitt, 2012; Tessier, 2012). Jewitt (2012) explains that participant "reactivity" (p. 10) to being recorded is many times exaggerated. The researcher clarifies that the length of the study and the research context where participants will be regularly observed lessens the effect of reactivity. In addition, Jewitt (2012) describes a paper where researchers used electronic recordings extensively throughout their studies. They found

that even in diverse settings and activities, participants felt comfortable with being recorded after a short period of time. Furthermore, Jewitt (2012) states that there are few empirical studies that demonstrate that electronic recordings have changed the behaviors of participants. Bloor and Wood (2006) explain that most people's acceptance of the use of electronics to record their views is assisted by the pervasive use of technology today.

The researcher used audio recordings during the interviews and the PBL PD meetings. During the pre and post interviews, the audio recorder was placed on the teachers' desks between the researcher and the teacher participant. Throughout the PBL PD, the audio recorder was placed in the middle of the table where the teacher participants were gathered so as to capture as much as possible of the verbal interactions of the participants. The audio recorder was turned on at the beginning of the PBL PD meetings and interviews and turned off at the conclusion of the PBL PD meetings and interviews.

A transcription software, HyperTranscribe, was used as an aid in the manual transcription of the audio recordings. This study's research questions and the literature review guided the codebook development. HyperRESEARCH, a computer-assisted software, was used for analysis of the audio data.

Human Subject Considerations

In the fall of 2014, this researcher asked the principal at XYZ for permission to conduct this multi-case research study. The principal asked that I present my proposal to the schools' philosophy team. The philosophy team is made up of one to two teachers from every grade level and the principal. The philosophy team helps make decisions that could possibly affect the school. I created a PowerPoint presentation that described my proposed study and presented it to the team. The team verbally stated that I could conduct the study during the 2015-2016 school

year. In addition, the principal of XYZ Elementary School wrote and signed a site authorization

letter for this researcher to conduct this study at XYZ Elementary School (Appendix J). This

study qualified as meeting Federal Exempt criteria under Category 2 (Office for Human

Research Protections, 2016) and was cleared by the Graduate and Professional Schools

Institutional Review Board in September, 2015 (Appendix K).

One of the researcher's responsibilities is to be concerned with protecting the

participants, the research site, and the data collected within the study. Prior to data collection,

each participant was asked to complete an informed consent form (Appendix D) that explains his

or her rights as a participant. Teacher participation in this study was strictly voluntary. The

participants are not anonymous, but their identities were protected. The researcher did not

include participants' names or anything else that could identify them in any reports of the study.

A pseudonym that is not related to information about the participant was used. All identifying

information was struck from the interviews, PBL PD meeting observations, transcripts, and

coding and was replaced with pseudonyms to protect confidentiality.

Once the initial interviews were complete, participants participated in PBL meetings from

September 2015 to April 2016. These meetings lasted from 30 to 45 minutes long. Meetings and

discussions were documented by audio recordings. Participants agreed via the informed consent

form to be audio recorded or they cannot participate in this research study. The audio recordings

were used for the purposes of this study only and will be destroyed upon completion of the study.

Although there were no anticipated risks involved with this study, there were possible

inconveniences associated with this study. These may have included carrying out research on the

participant's own free time. However, the benefits of this study, helping to create a more useful,

meaningful, and beneficial teacher PD for XYZ Elementary School, may have been a motivator to overcome any inconveniences this study may have caused.

Data Management

All audio recordings of the participants' interviews and audio recordings of the PBL meetings are stored in a password-protected file on the investigators' computer at her residence. Audio recordings of the interviews and PBL meetings were transferred to the investigator's personal password-protected computer at her residence the same day the recordings took place. The recordings on the audio recorder were immediately deleted once audio recordings were transferred to the investigator's personal computer. All audio recordings stored on the investigator's personal computer will be destroyed at the end of the investigator's defense. All the data collected from the interviews, vignettes, questionnaire, and audio recordings will be stored in a password protected file on the investigator's computer at her residence for three years and then destroyed.

Data Analysis

The interview data, PBL PD meetings data, and vignettes were analyzed and guided by the research questions, Creswell's (2013) generic data analysis strategy, and the theoretical proposition: A PBL approach to PD, an approach that utilizes research on effective PD, will be an effective means for teacher learning. This helped guide the codebook in HyperResearch. Additionally, the patterns found in the data will be used against the predicted one: teacher PD that promotes active learning, emphasizes collaboration, is sustained over time, is correlated to teachers' specific contexts and curriculum, and is coherent with the school as a whole are the characteristics of an effective learning environment for teachers. Using the pattern-matching technique will help link the research data to the proposition and build an explanation as to why

the patterns may or may not match (Almutairi, Gardner, & McCarthy, 2014). Along with the themes, pattern-matching will help to build a thick description and a clearer view of this case under study (Brown, 2008).

This researcher chose to use a combined approach to develop a data coding template. The researcher first developed a priori codes. A priori coding is where codes are developed before analysis and then applied to the text (Blair, 2016; Creswell, 2013). The a priori template that was designed for analysis of the data was based on Tharp and Gallimore's (2002) four-stage ZPD process used for adults during skill acquisition. Each stage is characterized by common approaches/behaviors that are consistent within each stage. The initial codes that were developed for the a priori template (Appendix K) were for the purpose of understanding how each teacher moved through the ZPD process and therefore assist in answering the research questions related to the purpose of this study. However, Creswell (2013) states that using a priori codes limits the analysis to the "prefigured codes" (p. 185) rather than allowing the researcher to be open to emerging codes during analysis. A combined approach to coding data is appropriate when a study aims to discover the meaning a participant assigns to phenomena or discover unpredicted aspects of a participant's experience (Gale, Heath, Cameron, Rashid, & Redwood, 2013). This researcher used both a priori coding and emergent coding to analyze the data. Last, this researcher had a peer-reviewer participate in the coding process to ensure reliability of the data analysis process.

Study Validity and Reliability

Terms that are frequently used to describe study reliability and validity in qualitative studies are credibility and trustworthiness. An examination of trustworthiness in case study is crucial to ensure reliability and validity (Golafshani, 2003).

One of the strengths of the case study is the collection of multiple types of data collected with different data collection strategies such as observations, surveys, and interviews. By using multiple sources for evidence, the researcher can look for corroborating and converging evidence (Yin, 2014). Providing multiple measures of the same phenomenon contributes to constructing validity (Baskarada, 2014). Furthermore, this will ensure that a plausible and holistic explanation of the data can be made (Merriam, 2009).

Data triangulation helps to strengthen construct validity. Triangulation is the process of collecting information from multiple sources so as to corroborate the findings. The most desired convergence occurs when three or more sources assume a single reality (Yin, 2014). Triangulating the data from the teacher interviews, observations, teacher belief vignettes, and the teacher beliefs questionnaire ensure accuracy of finding interpretation. In addition, each of the three cases were triangulated using a cross-case analysis process.

To strengthen internal validity a pattern-matching procedure was used during the coding process. Pattern-matching logic is considered a very desirable approach to case study analysis. This approach compares the empirical based pattern with a predicted one. The aim of pattern matching is not about confirming or disputing the proposition, but rather it is about building an explanation as to why or why not the patterns are matched. This results in greater validity and supports the conceptual framework of the case study (Almutairi et al., 2014; Yin, 2014). The proposition in this case study, which is derived from the literature, as well as the researcher's experience in this particular context, is: A PBL approach to PD, an approach that utilizes research on effective PD, will be a useful and effective means for teacher learning.

In qualitative research, a rich, thick description is a means of providing external validity or "transferability" (Lincoln & Guba, 1985, p. 219). A "rich, thick description" (Creswell, 2013,

p. 252) is where the researcher provides a detailed description of the participants, setting under study, and the themes of a qualitative study in rich detail (Lincoln & Guba, 1985). This can create "verisimilitude" (Creswell & Miller, 2000, p. 129), which is a description that generates for readers the feeling that they have or could have experienced the situations that are being described in the case study. A rich, thick description enables the reader to determine the applicability to other settings or contexts and make decisions about transferability (Creswell & Miller, 2000). The researcher describes this case study with rich and thick descriptions as a means to illustrate the findings and to allow for transferability.

Study reliability was ensured through using the same procedures for each case. All three subjects experienced the same PD intervention and data gathered based on pre-established interview protocols and observation protocols (see Appendices).

To ensure reliability of the data analysis several strategies were used. Creswell's (2009) generic data management and analysis strategy (p. 185) was used to ensure that no aspects of the data analysis process was overlooked. Data was reviewed multiple times relying on a constant-comparison process (Glaser & Strauss, 1967) and a peer-reviewer participated in the coding process. HyperRESEARCH software was used to document the coding process and assist with the categorization of the data into themes.

Chapter Four: Description and Understanding of Cases

This chapter presents a description of the participants' beliefs and findings based on the pre and post PBL PD interviews, PBL meeting observations, PBL meeting audio recordings, vignettes, and questionnaires. First, the context of the school and other background information is described in this chapter to help inform a deeper understanding of the analysis. Then the three cases are presented and analyzed separately. The themes that emerged from this analysis are presented in Tables 3, 4, and 5. Each case is presented in the following order — first, an introduction of the participating teacher. Next, a description of the participating teacher's beliefs based on the observations and interview, followed by a description of the themes that emerged after the coding process. Then the results from the participants' responses to the vignettes and questionnaire are presented. Following the results from the vignettes and questionnaire, an analysis is presented across the three cases. A cross-case analysis of the three cases unveiled similarities and differences within the three themes that emerged: Teacher's Beliefs about Student Ability, Teacher Epistemology and Responsiveness to Assistance, and Unplanned Events Cause Teachers to Revert Back to Beliefs and Shift Collective Goals. Last, the chapter closes with a summary.

Context

XYZ School is an alternative, school-of-choice that provides a traditional, back-to-basics philosophy of education and environment. XYZ School is a top-rated school, and many attribute its long history of standardized state testing success to the back-to-basics philosophy. In 2004, a new principal took over the reins at XYZ School from XYZ's former principal who was highly respected by both staff and the community. The former principal was a keeper of the philosophy and micromanaged the staff to make sure that teachers did not veer from the teacher-directed,

back-to-basics instruction. This principal was ousted by the district and replaced by a new principal. Teachers quickly discovered that the new principal did not believe in the traditional, back-to-basics philosophy of the school since he sought to make changes to the core back-to-basics philosophy. Many of the old-timers, teachers who had been at XYZ School for many years, started to worry that what made the school unique, successful, and a school-of-choice in the district was being altered. XYZ teachers banded together to fight the change in philosophy. Eventually, the teachers were able to stand their ground and maintain the school's traditional, back-to-basics philosophy. The old timers got together and wrote a statement that described the school's philosophy and created a "philosophy team" made up of XYZ teachers who meet once a month to ensure that school practices are aligned with the traditional, back-to-basics philosophy. In 2011, the principal was transferred to another school and replaced by another principal who appeared to support the traditional philosophy. XYZ School's philosophy is aligned with a transmissionist epistemology, where teachers' beliefs about teaching and learning are the process of transmitting information.

California adopted the Common Core State Standards (CCSS) in 2012. The CCSS is an educational initiative that focuses on developing the critical-thinking, problem-solving, and analytical skills of students (Preparing America's students for success, n.d.). In 2012, with pressure from the school district, XYZ School began to look at how to incorporate the CCSS while maintaining the traditional, back-to-basics philosophy of the school. Teachers met with their grade level teams to learn the standards and develop lesson plans that were aligned to the CCSS and XYZ's traditional, back-to-basics philosophy.

PBL PD

Three fifth grade teachers, Carl, Larry, and Sandy, took part in the study. The researcher also had a dual role in this study, one of researcher but also a facilitator of the group. The group met regularly in Carl's classroom where we discussed the problem that we were working on. We also had informal discussions that took place during lunch, prep periods, or in passing.

Before the study took place, the district had purchased new math CCSS aligned textbooks for all of the elementary schools within the district. Also, the previous school year before the study took place, all K-5 teachers participated in an ongoing math PD to help teachers learn how to teach math problem-solving skills.

Carl, Larry, Sandy, and this researcher agreed during our first meeting that we wanted to focus on math for our PD since the district's focus was math also. Larry explains, "I am thinking ultimately math would be easier, not to say that that is the only reason, but obviously we are all dealing with, we are all in it together even though you (Sandy) are brand new… I mean who knows what else the DO (district office) wants us to do in terms of [math PD], maybe there is going to be some type of group evidence of some type." Larry also expresses concern about the fifth-grade math assessments in the spring, "Maybe in the springtime they will be throwing [at our fifth-grade students] all these [math] problems and there, here, here you go…I do not know whether or not by that time they will have really helped the kids develop the skills or helped them attain the tools needed to solve a [math] problem like that cell phone problem. I do not know." The cell phone problem Larry mentions was a difficult math performance task that contained several multi-step word problems. We discussed the possibility of focusing our PD on critical thinking. However, Carl was not comfortable focusing our learning on critical thinking. He pushed the group to focus on problem-solving instead,

CARL: Some high models of teaching critical thinking, are mired in the mud. For me, I don't know what teaching critical thinking looks like. I don't even know what that is exactly. I have to admit if someone said: 'I want you to teach these kids to think critically.' I can do it a little bit in social studies, I have a better feeling for it, but I don't think I hit many of the kids with that model … I don't know how to teach critical thinking, really.

Many teachers in the United States hold a traditionalist belief that math is a static body of knowledge where there is a set of rules to be followed step by step which leads to a right answer (Stipek, Givvin, Salmon, & MacGyvers, 2001). On the other hand, many teachers believe that social studies is based on a critical interpretation of information (Voet & De Wever, 2016). Nevertheless, Larry, Sandy, and I left the first meeting with the idea that we were going to focus on critical thinking with a focus on math. The three of us researched critical thinking during our SDL phase and came to the second meeting with information to share. Carl again was resistant to wanting us to focus our PBL PD on critical thinking,

MICHAELA: When I went through the [PBL PD] transcripts [I saw that], we did bump around problem-solving and we even asked, 'How does problem-solving relate to critical thinking?' Then, we talked about transfer. How does this transfer to other areas? We talked about math and reading. I took everything [we discussed] and I figured, how do we teach the critical thinking skills that are expected of students. Let's re-define the question. That's how I kind of took it from everything [we said] in the transcripts.

CARL: To me, that's less compelling.

Carl continued to push for problem-solving so that eventually our focus and the question that evolved from the group was, "How can we help our students become better problem solvers?"

The team buys-in. During the cyclical PBL tutorial process, learners work in small collaborative groups where the facilitator guides the group through a six-step PBL learning cycle (Figure 1; Hmelo-Silver, 2004). As a group, we identified our knowledge deficiencies (Step 4 of The PBL Learning Cycle, Figure 1) and discussed what resources we could use to help our students. Dr. Whimbey's name came up often during our first few meetings when we discussed what information we needed to answer our guiding question. The former XYZ principal, Dotty, who was very highly respected by the XYZ staff had purchased several books on reasoning and analytical instruction by Dr. Whimbey. Both Carl and Larry thought that Whimbey's work could be useful to help students become better problem solvers, and additionally, since Dotty recommended Whimbey books for XYZ teachers, they felt that it would fit into our direct instruction model:

> CARL: He's the man. I thought Whimbey is about [problem-solving]. We got this book from Dotty.
>
> LARRY: Dotty was a big-time advocate.
>
> CARL: She showed it to us, and it's about reading. It's about critical reading which is what [our focus] is.

After our second meeting, Carl found a book by Whimbey titled, "Problem Solving & Comprehension" by Whimbey, Lochhead, and Narode (2013). This book is about how to analyze and understand math word problems using the Think Aloud Pair Problem Solving (TAPPS) method.We decided to use it as our resource to help us learn how to teach our students problem-solving skills. After every meeting, we made agreements to read sections and then discuss the reading. Everyone in the group liked this book:

LARRY: [I]t's pretty interesting given what it's talking about and stuff. I think it's really, well, it's clean.

SANDY: Right. It's not bad.

CARL: Of course, I would expect nothing less from Dr. Whimbey.

LARRY: All hail, Dr. Whimbey!

In their book (Whimbey et al., 2013), Whimbey and his co-authors describe their program called Think-Aloud Paired Problem Solving (TAPPS). The book takes the reader step-by-step on how to use this strategy in the classroom and gives several problems for students to work on to develop problem-solving skills. The first step is modeling the process to students. Once the process is modeled by the teacher, students then use the TAPPS strategy to solve problems together. The book discusses the importance of students taking turns as both problem solver and listener. The listener's role is to check for accuracy and demand that the problem solver vocalizes his or her thinking. This, in turn, places demands on the problem solver to explain his or her thinking which requires reflection on the problem solver's part. The level of reflection that is required during the pair problem-solving not only aids the students in solving the problem but also has the ability to change student performance.

In Chapter 15, the last chapter of the book, the authors claim that the TAPPS strategy will help change the way teachers teach. This chapter discusses the importance of allowing students to actively work through problems on their own. Additionally, the chapter explains that one of the key roles for this strategy to work is the listener. In the absence of an active listener, the problem solver's explanations will go without support. As a teacher is listening to a student's explanations the teacher should listen to understand how the student thinks and ask questions, as opposed to helping him or her get to the answer quickly. We went through the book sequentially,

chapter by chapter. Chapter 15 was the last chapter we read and discussed. Chapter 15 lays out the case that when a teacher is lecturing (direct instruction), it is most likely that there are students who are not listening. He claims by using TAPPS, an active method of learning, all students are engaged. The book uses several constructivist strategies or assists to support student problem-solving such as modeling, questioning, feedback, and cognitive structuring (Tharp & Gallimore, 2002). The teachers as learners' ZPD was constructivist teaching methods to support student problem solving. The Whimbey et al. (2013) book helped to scaffold our learning during our group discussions. Scaffolding is not always dependent on one person but can be provided by, for example, peers, available material, software, books, and/or the internet (Holton & Clarke, 2006; Puntambekar & Kolodner, 2005).

Case Study 1: Carl

Introduction. Carl has taught fifth-grade at XYZ School since 1995. He was one of the old-timers who are very involved in the maintenance and structure of the school's philosophy. He takes part in the philosophy team meetings and has a strong belief in teacher-directed instruction. The physical arrangement of desks in Carl's classroom, as are all the desks in classrooms at XYZ School, is all desks are in straight rows facing the front of the class. This layout is suitable for teacher-directed instruction. During instruction, Carl stands in the front of the class where he is the focal point as he lectures. His primary role is active, whereas his students' principle role is to passively listen to the information that he dispenses. All students in his homeroom independently work on the same task regardless of the level of difficulty for some students.

XYZ School groups students by ability in math and reading beginning in fourth grade. The purpose of ability grouping at XYZ School is to allow the teachers to pace their instruction

based on the academic ability of the learners in their math and reading classes. Teacher-directed instruction facilitates teaching whole groups based on student academic ability with minimal differentiation. In fifth grade, XYZ students are grouped into either low, middle, or high math and reading classes. Students switch classrooms everyday from their homeroom class to their assigned math and reading classes. In the 2015/16 school year, XYZ School fifth-grade had four separate math and four separate reading classes with each subject having one low ability class, two middle ability classes, and one high ability class. Students are ability grouped based on fifth-grade assessments given by the fifth-grade teachers at the beginning of the school year, fourth-grade teacher recommendations, and fourth-grade standardized Smarter Balanced Assessment Consortium (SBAC) scores. Carl teaches the "low" ability math students and the "high" ability reading students.

Beliefs. Carl's beliefs are associated with a transmission-type epistemology which is the belief that knowledge is transmittable, unchanging, rapidly learned, innate, simple, and specific (Howard et al., 2000; Maor, 1999). Some of these beliefs are evident by the committees and activities that Carl freely chooses to take part in. Originally, Carl was not on XYZ school's philosophy team, however, he volunteered to take part in the monthly meetings until he was eventually chosen to be a part of the team. Now he is a key member of the team. He is also very outspoken about the philosophy and often belittles a social constructivist style of teaching. For example, he states: "there's some pretty efficient models out there already, and there's no reason for me to waste time with you (student) coming up with something that's already happened. There are a lot of interesting things with math, and multiplying double-digit numbers isn't one of those things." Teachers who hold transmissionist epistemological beliefs fail to see activities as

meaning-making processes (Brownlee et al., 2011; Kang & Wallace, 2005; Schraw, Brownlee, & Berthelsen, 2011).

During our pre-PBL PD interview (Appendix C), Carl explained, after reading Schraw and Olafson's (2002) Adapted World View Vignettes (Appendix A), that he preferred Vignette 1, "it's like this is my model, and I think I go more towards Vignette 1 in elementary school." Teachers who prefer Vignette 1 hold beliefs that there is a "core body of knowledge" that is learned by transmission from the expert teacher to the novice student. Vignette 1 (realist) is correlated with an active teaching role where students are expected to learn passively (Schraw & Olafson, 2008). Additionally, a realist view is positively correlated with the number of years teaching. Teachers with service of more than 15 years typically endorse a realist position (Schraw, 2013). Carl has been teaching at XYZ School for 23 Years.

However, Carl does believe that Vignettes 2 (contextualist) and 3 (relativist), which are related to constructivists practices (Schraw & Olafson, 2008), are appropriate for older students,

> CARL: I basically agree with the middle section of this (Vignette 2). I believe there is knowledge that's subject to interpretation in certain things, I mean, not double-digit multiplication. I think that the older you get, the more you have to be able to do this kind of thing. In elementary school, we want to expose them to these opportunities and get their feet wet in that…I liked this little part (pointing to a section in Vignette 2). I think opportunities to do all these things are important, but just opportunities.

Carl stresses "efficiency" as we discuss the vignettes, "Again, at 10, I don't feel it's the most efficient way to do it…When you got to an upper-division college course or a seminar or something, you'd want to be able to do that (pointing with his index finger to Vignette 3)." A teacher-directed instructional approach emphasizes knowledge that is rapidly and efficiently

learned. Teachers who hold transmissionist epistemological beliefs (realists) see discussions as an inefficient means of communicating information.

Themes. Three themes are presented in Table 3. During and after the coding process, the researcher identified important quotes that were used by Carl during his Stage 1 Difficulties. This researcher then sorted the important quotes by Carl by placing them into similar categories (Table 3). The top three themes that emerged are related to this study's research questions and are discussed below.

Table 3

Carl Themes

Example Quotes	Theme	Frequency
"Of course, this happens to be a particular 30 people, that belong sitting there together." "My kids, the lower kids, are at least aware that this is an issue with them."	Low students incapable	15
"Yeah, exactly."	Larry Agreement with Carl	23
	Larry Transmissionist Epistemology	12
"That's hard, that's a hard, that's hard."	Stage 1 Difficulties	23
	Transmissionist Epistemology	15

"Of course, this happens to be a particular 30 people that belong sitting there together." Carl teaches the low math group. He believes that the cognitive demands of the Think-Aloud Paired Problem Solving (TAPPS) are beyond the capabilities of his low math students, "The problem we have, I mean, today we worked on squaring our books up on our desk…bad analogy, [but] that's exactly what I have to do with them. I have to say, 'Now write this down.'"

Carl expresses his belief that most of his low-achieving students are incapable of higher order thinking skills and that his students "[are] aware. My kids, the lower kids, are at least aware that this is an issue with them." The TAPPS method is designed for all learners to actively engage in problem solving. The researchers explain that this method is preferable to direct instruction methods since all students are participating (Whimbey et al., 2013).

Carl believes that some of his students are more capable of higher-order thinking than others and that those who he sees as not capable need and want a transmission approach to learning, "I got about six people every year, on average, the average that are like 'We're with it, I get this idea.' Other students are like 'You sure I just can't memorize some dates?'" Zohar, Degani, & Vaaknin (2001) explain that low-achieving students are taught to be passive learners and that their learning suffers when teachers do not believe that it is appropriate to provide explicit instruction in higher order thinking skills.

The TAPPS approach to problem-solving is a method for teaching metacognition. The problem solver must verbalize his or her thoughts to the listener. The listener's role is to ask for clarification. The problem solver must then evaluate his or her ideas in relation to what the listener asked. The listener is a key role of the TAPPS strategy. The role of the active listener is to assist the problem solver to self-reflect (Whimbey et al., 2013).

During our PBL PD meeting, Larry, Carl, Sandy, and I decided to use Whimbey et al.'s (2013) think aloud strategy to model problem-solving with our individual math classes and then have our students take turns as both problem solver and listener. We also explained and passed out written instructions for the problem solver and listener roles. We wrote a script together to use to model our problem-solving strategies to our math students. Larry, Sandy, and I all performed the think aloud in our individual math classes and then had our students turn take

problem solver and listener roles. Carl, however, veered from the strategy that we had agreed to use with our students in class, and what Whimbey et al. (2013) explained is a valuable skill for students to master and did the following with his students instead:

> CARL: I said, "I just did one of those with you, as a class. I want you to go home, and I want you to write a script. " I decided to do that because I thought a lot of these cats, They're skipping stuff. If they did it out loud it would be a mess. So I said, "You know what? I want you to do what we did, which is write out step-by-step this is what I did." I had to spend a lot of time trying to overcome what I perceived to be a bunch of people going, "I don't need to do this," or, "This is just another thing," or "whatever," or, "This is silly," or, "This is an opportunity for me to not do anything," or whatever they think. The myriad of reasons that they have for not paying attention.

Carl does not believe that his low math students are capable of engaging in the TAPPS learning strategy, however, he does feel that it is a valuable learning strategy for our higher achieving math students,

> CARL: Well, you want to probably do it (problem solve daily) as much as possible. I don't know that I'm set up to do it daily. We have so much trouble coming into class and getting our stuff out to correct. That's my thing. I have kids that come in everyday and just sit, and don't do anything, and it's January. Get with it. And that's what we have to practice every day.

Carl believed that higher order thinking skills are only for those students who have already mastered basic math skills. He does not think that all students can engage in the cognitive demands of the TAPPS method to problem solving. Carl remained in Stage 1 of his progression through his ZPD.

"Yeah, exactly." Tharp and Gallimore (2002) state that in Stage 1 of a learner's progression through the ZPD, teachers must develop "intersubjectivity" (p. 89) or a common understanding of the purpose of the task to develop a deeper understanding of the task to be performed. For Tharp and Gallimore (2002), intersubjectivity is best accomplished through conversation with more capable others. Once intersubjectivity about the task has been reached, teachers can be further supported by peers or facilitators through questioning, feedback, and cognitive structuring. A dynamic developed between Carl and Larry of reinforcing each other's transmissionist beliefs. Larry especially tended to validate Carl's transmissionist beliefs. When Carl struggled or described his experiences, the feedback Carl received from Larry would validate Carl's transmissionist epistemological descriptions of the task as opposed to Whimbey et al.'s (2013) description of the task to be completed.

> CARL: It's almost like you'd have to have a high kid listen to a lower kid because the high kid can do some of that better. They are more apt to be able to go 'You missed something.' It's really hard to even get them to even focus enough to listen to what you're saying. 'Oh, I'm the listener, that means I don't have to do anything.'

> LARRY: Yeah, until it's my turn to share, and then it's just an empty exercise. You share, I share, we're done.

Several times Carl expressed his beliefs about the role of the listener and the difficulties he himself had in this role. Tharp and Gallimore (2002) explain that in Stage 1 the learner may not conceptualize the goal of a task in the same way the more capable other does. Carl received competing messages from Larry that did not assist his progression through his ZPD. Larry's feedback supported Carl's transmissionist epistemology instead of supporting the new method of instruction. In contrast, when the book was used as a frame of reference or Carl was given

feedback by Sandy or me, Carl would shift his response to our growing intersubjectivity of the importance of the active listener during learning,

> CARL: Because pair-sharing and reading can be that way... Sometimes I listen to what they're saying and it's like, it's sort of like, 'is Mr. [Carl] standing next to us? Let's share something, and if he's not, let's blow off a minute.' You know, kind of, I mean it can be that way. That's where I didn't really like how [the math trainer] phrased it. But that gal said that she wanted, when [students] pair-share, she wanted the kid to say what the other person was saying.

> LARRY: Yeah, exactly.

> MICHAELA: I've done something similar. That's where I said [to the class] 'pair-share.' 'The first [student] is the teacher, then (switch roles). Now you're the student, listening.' I do hear students, when they're engaged, and they'll say, 'well, you forgot to do this or' ... They enjoy teaching [one another], they enjoy being active.

> SANDY: Depends on how you presented it, rather than just 'listener.'

> MICHAELA: Right.

> CARL: Right, and we listen, and really doing that active listening is important.

> MICHAELA: It is.

Throughout the sessions, Carl had trouble developing intersubjectivity with the constructivist learning goals of the Whimbey et al. (2013) since he had competing frames of reference. He had Larry who would support his transmissionist epistemological frame of reference, versus the book and our conversations that were trying to promote more constructive learning.

CARL: And the listeners, if they're advanced, and they need to really do a good job, that'd be great. But I'm not going to worry too much about it. I'm afraid that I have already started to focus on the listener and wait a minute. It's really about (pretending to be student talking), 'this is what I know, this is what I'm trying to find out, this is how I'm going to look at the problem, this is what I read, and I need to start thinking about my problems in that way. So that by the time I'm in high school and college I'm a good problem solver.' I'm gonna pass the baton to sixth grade and this kid's going to not subtract just because it's the last problem on a test, and one number is bigger than another. Which is what happened for about nine people on that last math test, quite a significant number. I want that to start going away, and this is why we picked this problem [to work on]. But I was starting to get hooked on the listener, and maybe we need to remember that it's not about the listener.

MICHAELA: It is important, I think, that when they're reading the problem, and as they read it they have to think aloud, they have to think carefully about the problem. They can't just go and quickly solve it. They have to articulate, and when you articulate you have to put it in your mind what it is you're trying to do.

CARL: And the more practice you get doing that, the better. Maybe the listener is going to pick up something from the person, thinking, "Oh, hey. That was pretty good."

In the cycle of teacher review, it was Carl's skip year and he was not required to have a formal or informal evaluation. Both the principal and vice principal informally walked through our classrooms but did not place pressure on Carl as they did on the teachers who had formal or informal evaluations. Carl's walkthroughs occurred infrequently and typically without comment. However, it was understood that the district, our principal, and vice principal were looking for

engagement and collaboration. As Carl explained, "The kind of thing that when these people from the district office walk in, they love that , 'Look at the student engagement!'" Our new vice principal, Tammy, was especially keen on student engagement and collaboration, although, because of the evaluation cycle, she did not place the same pressure on Carl, as on Sandy and Larry.

> CARL: If [vice principal] told me to do that, then every time she'd walk in we'd be pair sharing.
>
> LARRY: Alright, everyone pair share!
>
> CARL: Alright, I want you to pair share! (Pretending to be shocked students responding to his pair share request) 'But we're doing the Pledge of Allegiance?!'

The vice principal did not pressure Carl to work through our difficult and challenging task. Since Carl lacked relevant Stage 1 support, Carl could not develop intersubjectivity of the learning goal. Carl stayed in Stage 1 of his progression through his ZPD.

"That's hard, that's a hard, that's hard." Carl repeatedly discussed throughout the PDs how hard the TAPPS teaching method is for him, "It's just one of those things, it's our first foray into it. I found it more difficult than I thought, even with my script, to not just go, 'This is what I did.' It's hard." Tharp and Gallimore (2002) explain that the overriding experience of most teachers as learners in Stage 1 of their progression through their ZPD is confusion, stress, anxiety, resentment, and self-doubt.

Carl became frustrated with the TAPPS strategy the first time he modeled his problem-solving skills with his math class. Tharp and Gallimore (2002) explain that learners may experience periods of extreme difficulty and stress during the early periods of Stage 1 skill acquisition. Carl chose some students in his class to be the listener as he problem solved. One of

his chosen listeners did not understand her role and thought that when he asked a question, he was asking her directly, "Marsha said, 'Why isn't it...?' and then she gave me the answer. I said that's interesting, but that's not what the listener is supposed to be doing." Carl became frustrated with the modeling process and engaging students to take on the active listener role. He pretends he is talking to his students: "I don't think you can listen and I know how hard it is for you to ask a good question because I have a hard time [too]. I would have a real hard time sometimes knowing, 'Why did you do that? That is my question. Go ahead.'" He reiterates several times that students do not have the capacity to ask questions and that he himself finds it hard, "I don't think the questioning part is ever going to get (he pauses), [questioning] is a chore." The TAPPS method requires that the teacher do more questioning and listening, and to "BACK OFF" instead of giving students the answers to questions (Whimbey et al., 2013, p. 383).

Problem pair share challenges the role of the teacher as the information dispenser and answer verifier (Richards, 1991). Carl experiences frustration and stress which is characteristic of Stage 1 difficulties. However, we begin to see Carl demonstrate a higher level of competence in Stage 1 of his ZPD as the questioning strategy gradually becomes internalized. He talks about being the listener during the second to the last PD session, "I think it is hard. When I do it, when a kid asks me a question and I don't give him the answer, but I give him the way to go. I am almost proud of my[self] – and I go (Carl says under his breath), 'I am a professional.' I didn't give him the answer. It is hard. It is a hard thing to do."

Case Study 2: Larry

Introduction. Larry has been teaching at XYZ School since 1997. His classroom, as Larry describes it, is "Spartan" with minimal decorations. The desks are lined up in neat and orderly rows facing the front of the classroom. When teaching, Larry stands at the front of his

class so as to direct the learning and ensure a disciplined and passive classroom environment. His instruction emphasizes delivery of content and his students' ability to reflect what he delivered on assessments. Students who typically do well in his class are those who are skilled at memorizing terms and facts and mirroring Larry's lectures on the assessments. His homeroom and reading class assessments are generally multiple choice along with short answer questions. Larry teaches the "high" ability math students and the "low" ability reading students.

Beliefs. Larry's beliefs, as we know from the vignettes (see below), are associated with a transmissionist epistemology, which is the belief that knowledge is transmittable, unchanging, rapidly learned, innate, simple, and specific (Howard et al., 2000; Maor, 1999). Although Larry is not involved in discussions with the staff or on any committees that involve the philosophy, he does have a strong belief in the direct instruction, back to basics philosophy of the school. His beliefs are evident in his style of teaching where his lessons are predominantly highly structured and efficient. His beliefs are evident during our pre-PBL PD interview (Appendix C),

LARRY: I think it's really important that the kids learn it the right way the first time. It's not so much that they go about on their own trying to unearth it. I think that sometimes that does happen and that can happen, but it's just a far less efficient way of trying to impart information and knowledge.

Larry explains "[w]ith vignette 1, I definitely lean more to the agree, strongly agree side." Vignette 1 is associated with a realist worldview and is related to transmissionist teaching practices (Schraw & Olafson, 2008). A teacher who holds a realist worldview believes in the simplicity of knowledge where students need to master specific basic core skills and that the information that he or she teaches requires memorization of individual fact-based subject matter. A universal curriculum that is transmitted from a knowledgeable teacher to his or her students is

usually endorsed by teachers with a realist worldview (Schraw & Olafson, 2008). Larry demonstrates his realist beliefs with the following statement, "Ultimately I do believe that the way we (XYZ School) go about it is better. I think kids need to have that foundation. You can have this knowledge in place. It's okay to be much more prescriptive." However, Larry also states that he agrees with Vignette 2 representing a contextualist worldview,

> LARRY: I do agree…I think for this there is definitely a place for it. It may seem as if it runs contradictory to my feelings about vignette one, but again, depending on the subject area, this is equally valued.

Contextualists believe that teachers are facilitators whose role is to support learners to construct shared understandings based on the context it is learned in. Knowledge is constructed collaboratively as opposed to transmitted by the teacher. Larry's transmission approach to learning is contradictory to a contextualist worldview where teachers adopt a student-centered approach, but when he discusses subject area, he shows that he places different subject areas into different types of knowledge acquisition. Larry holds transmissionist beliefs about math instruction, where math is a set of rules to be followed step by step which leads to a right answer (Stipek et al., 2001). In contrast, he views social studies as more interpretive in nature and therefore a more contextualist endeavor.

Themes. Three common themes are presented in Table 4. Throughout the coding process, the researcher identified key quotes by Larry that was also related to this study's research questions. The researcher then sorted the important quotes by Larry and placed them into similar categories (Table 4). The top three themes that emerged are also related to this study's research questions.

Table 4

Larry Themes

Example Quotes	Theme	Frequency
"[I]n terms of what I would expect my kids to do, in terms of demonstrating critical thinking, it's much more open ended."	Epistemology strong implication for the way Larry teaches. Transmissionist epistemology	20
"But yeah, it is tough. I mean, I know it's tough for myself."	Deeply rooted prior misconceptions will continue to compete with more constructivist forms.	11
"Really, I'm going to at least tell them, or at least threaten them, with the whole notion of I'm going to pair you up with a 3rd grader.:	Stage 1 Difficulties. Only conceptualizes a portion of the overall goal.	8

"[I]n terms of what I would expect my kids to do, in terms of demonstrating critical thinking, it's much more open ended." Larry teaches not only the high math students but also the low reading students, the majority of whom are in Carl's low math class. Larry views the lower achieving students as having "an element of laziness in them" and "a negative mentality." He also explains that, "they view themselves as not having a chance, really, they're not going to get this." Larry uses the metaphor of learning to play basketball to describe how Carl's low achieving students should learn problem-solving:

LARRY: Yeah, in the beginning, it's going to seem like drudgery, but it's - yeah, it'd have to be extremely prescriptive. It's like learning any other skill, learning how to play basketball. You're just dribbling…You're just dribbling. 'Huh?' (pretending to listen to a student) You're just dribbling, dribbling, back and forth. 'When do we get to shoot?' You're just dribbling. You're dribbling. Now you're going to dribble with your left down the court. Now you're going to dribble back with your right. All that and then you shoot.

No dribbling. You just shoot. Shoot from here. Shoot from me now. I want to see you, and then eventually you get to put everything together.

Larry believes that only once the simpler steps are achieved, then the student is allowed to move on to higher order thinking tasks. Larry and Carl's lower achieving students generally stay in the simpler "drudgery" stage of the learning process since they believe lower achieving students are "stuck" and cannot move past this stage.

On the other hand, Larry feels that his higher-achieving math students are capable of handling more complex tasks. "I probably have, of the four of us, it's probably easiest for me to do things in math because I can get those kids like, all right, slow down, we can do this." He believes his math students are capable of engaging in the TAPPS method of learning,

> LARRY: For math, we did the pair-sharing, the problem-solving, and it worked out really well for my class. I have the advantage, of course, from there. They're more advanced, but I think they didn't simply blow off or laugh off the whole notion of thinking out loud, sharing, and having the other person listen. I think for what it's worth, they did a good job, and they were willing. I had the listeners share out the strategy that the thinker offered. So that was good. That was good. Maybe next time I'll have them get into groups of four after that. I'm serious.

Larry clearly establishes his beliefs that his high-achieving students are able to engage in higher order thinking tasks such as TAPPS, whereas, these same tasks are beyond the capabilities of the lower achieving students. During Stage 1 of Tharp and Gallimore's (2002) ZPD framework, the learner may not conceptualize the learning goal in the same way the expert does. Larry is in Stage 1 of his ZPD because he does not conceptualize Whimbey et al.'s goal that all students can engage in TAPPS method for problem-solving and reflection.

__"But yeah, it is tough. I mean, I know it's tough for myself."__ In our PBL group, we read that most teachers believe that when they ask a question of their students, they must listen for the correct answer as opposed to asking students clarifying questions to explain their thinking. Many teachers have been trained to use a direct transmission approach to instruction where recitation of transmitted knowledge is evidence of student learning (Whimbey et al., 2013). Whimbey et al. (2013) state that students who come from a traditional transmission approach to learning will most likely resist their teachers' efforts to change the system that they are accustomed to. XYZ School is a traditional, back-to-basics school where recitation of transmitted knowledge is valued. Larry, who has taught at XYZ School for 18 years, struggles with the TAPPS questioning method. During one of our discussions, Larry describes his belief of how difficult it is for adults and students to question,

> SANDY: The dynamics, being attentive, knowing how to listen, and knowing how to constructively give questions. I was going to say criticism but...
>
> LARRY: Yeah, I think that's probably the most difficult part because it's hard enough for many adults to be able to do that, being tactful. Also…to be able to, you know, if…you want to probe, you want to hackle out of that other person to share, it's very tempting for you to, you know. I can see it happening to a lot of my students, 'okay, I'm not going to put you down. I'm not going to say it's wrong, but I'm just going to ignore what you said and I'm going to dive in and share with you what I did.' Which is, I mean, you're being nicer, but, 'oh by the way, what you shared, it's…'
>
> CARL: 'Poor misguided individual.'
>
> LARRY: 'Yeah, so let me just tell you [the answer].' Because it's far easier, it's far easier just giving the solution versus you explaining how [you solved the problem].

Larry focuses only on a portion of the TAPPS method instead of seeing how the questioner role is essential for reflection. Tharp and Gallimore (2002) explain that learners only gradually come to understand how the elements of the activity relate to one another and then eventually understand the overall meaning of the performance. On another occasion, Larry explains how the questioner role is difficult for him and also demonstrates his misconceptions of what the role of the questioner is,

> LARRY: But yeah, it is tough. I mean, I know it's tough for myself. Think back to that [math professional development].
>
> CARL: Julie, [that teacher] at Jackson School (where math PD first took place), when she [gave the wrong answer to the math problem]?
>
> LARRY: No, not Jackson School, but at Roland School (second PD)…
>
> CARL: Oh, both those times, when they let those [teachers] go [on, thinking that they had shared the right answer].
>
> LARRY: Left them dangling. Because what [the teachers] shared was wrong. I felt like I wanted to say something. But gee.
>
> CARL: The [math trainers] made it positive, 'That's an interesting approach.'

In the above conversation, the PD trainers modeled math talks where they asked teachers to voluntarily share aloud how they solved the problem. The goal was to show that multiple strategies can be used to solve the problem. During both trainings, a teacher shared aloud and solved the problem incorrectly. The trainers, however, did not continue the questioning process until everyone understood the problem, including the person solving the problem. Larry looked to the trainers as experts in math talks and when the trainers did not continue questioning the teachers to dispel them of their misunderstandings, Larry developed a misconception that

constructivist questioning means that the questioner allows the learner to "dangle" or believe that he or she solved the problem correctly even when they were incorrect. Understanding is ordinarily developed through feedback or modeling of the task. Only when a conception of the task has been acquired through assistance can the learner be assisted by other means (Tharp & Gallimore, 2002). Larry continues the conversation, explaining his misconception further,

> LARRY: And it does require a lot of patience. To just sit through it knowing that this person is just on the wrong track. Just going down the wrong path, that's such a higher order skill.
>
> MICHAELA: But you're not supposed to let them go down the wrong path as a listener. You're supposed to repeat what they're doing and say well have you tried something else?
>
> LARRY: No, but let them finish their sharing first.

The above statement reflects Larry's misconception that the listener allows the problem solver to go "down the wrong path" and that the listener does not "continually check for accuracy" (Whimbey et al., 2013, p. 28). During our second to last PD meeting, after we read the last chapter in the Whimbey et al. (2013) book, Larry describes how he believes that the process Whimbey describes is good teaching, yet he still holds on to his misconceptions,

> LARRY: I think the thing that stood out to me is really more that it struck home in terms of how I ought to be teaching if I want to really promote student understanding of problem-solving. I need to - because it is so easy for me to want to interject, 'no, no, you are doing it wrong.' They recommended only to, as you are playing up the scenario [with the student] even though it seemed a little high handed, play it out. If they make a mistake, even with kids, you try to show them how difficult it is to remain quiet, but just let the person think it through. I would have a very hard time. I admit. I would have a

very hard time at that [PD math] meeting. Letting someone hang. What if that person never figured out that [he was] doing it wrong. But I don't think that this book, it's not saying…

CARL; I didn't even catch that part of it [in the book].

Carl responds to Larry that he does not recall Larry's claims that the listener remains passive during the problem-solving TAPPS process. Whimbey et al. (2013) describe the listener role as active, not passive. Although we had read the entire Whimbey book by this point in the above conversation, Larry continued to struggle with his misconception that the listener is "quiet" and allows the problem solver to "hang" versus the actual textual evidence in the Whimbey et al. (2013) book. Larry only focused on a portion of the TAPPS task to be acquired. Larry stayed in Stage 1 of his ZPD because he could only conceptualize a portion of our learning goal.

"Really, I'm going to at least tell them, or at least threaten them, with the whole notion of I'm going to pair you up with a 3rd grader." During the pre PBL PD interview, Larry discusses what he likes about the contextualist vignette, "What really stands out to me, the good part, is I think it is important to teach students to distinguish between good and poor arguments. That's ultimately what we will, we want kids to develop into good critical thinkers, and that's the key." The group chose Whimbey et al.'s (2013) TAPPS method as it helps develop critical thinking and analytical reasoning skills. Whimbey et al. (2013) explain the importance of the active listener role for both teachers and students to help the problem solver reflect on his or her thought processes. Although Whimbey et al. (2013) describe the importance of both the problem solver and the listener being active participants equally, Larry devalues the role of the listener. He characterizes the role of the listener with the following statement he made, "Yeah, until it's my turn to share, and then it's just an empty exercise. You share, I share, we're done."

Larry does not understand that the role of the listener is an important component of the TAPPS method. Tharp and Gallimore (2002) explain that in Stage 1 of the progression through the ZPD, the attention of the learner is typically focused on only a small segment of the activity or learning to be developed. The TAPPS listener/questioner role helps the problem solver self-reflect (Whimbey et al., 2013). Larry demonstrates his depreciation of the role of the listener and the beneficial role peers play in problem-solving when he suggests the following activity,

> LARRY: Now I don't know whether or not I'm going a little bit too far off, but I always tell the kids, "look, you won't really convince me you understand a concept unless you're able to explain this in terms that, let's say, a third grader would understand, or a second grader." It's one thing for you to explain in some high way, like the books, but if you're able to break it down into the most basic conceptual forms, then that means that you really understand it. So, I was just thinking that it's sort of, in a way, artificial when they're explaining it themselves amongst themselves, but if we were to pair them up with a third grader. I know some of them and I don't want this getting too crazy, but ...

Larry further describes how explaining to a third grader would benefit Carl's low achieving students, "I think that, you know, [Carl's students will] be more willing. It's like, "Hey, I might actually know something that someone else doesn't." For whatever reason, that's going to boost their confidence and perhaps their attitude toward doing this, "Hey, I'm going to take it seriously because it's an opportunity for me to showcase my intelligence." Larry overlooks that the purpose of our PD is to help our students become better problem solvers. Asking fifth-grade students to solve a third-grade problem and engaging in a one-sided conversation with a third grader will not help them become better problem solvers.

Larry focused mainly on one component of the TAPPS method, the problem solver, which is only one portion of what Whimbey et al. (2013) describe is important for learning how to problem solve. Asking the problem solver to describe his thinking forces the problem solver to examine his ideas as he communicates. He then must evaluate his ideas in consideration of the listener's interpretation of what he is saying (Whimbey et al., 2013). Tharp and Gallimore (2002) state that at the beginning of Stage 1 of a learner's ZPD, the learner's attention is usually focused on only one part of the task to be learned. Learners must understand some conception of the overall task before other means of assistance can be used to help them progress through their ZPD (Tharp & Gallimore, 2002). Larry's focuses on only a small segment of the learning to be developed. He cannot receive assistance in other forms until he understands the meaning of listener/questioner role.

During PBL PD meeting 4, Larry agrees to try the TAPPS method in his math class. We created a script together during our PD meeting and made a plan to model how to do the TAPPS method with our math students. When we came back to reflect on our experiences, Larry explains that the experience was positive, "I think for what it's worth, they did a good job, and they were willing. I had the listeners share out the strategy that the thinker offered." Although Whimbey et al. (2013) explain that the problem solver both write and talk through the problem, during our last PBL PD session, Larry explains how he did not like the discussions his students had because they were not writing down the steps that they took to solve the problem,

> LARRY: They want to just talk it out. When I look at their papers, just the [solution to the answer] was there. I was really encouraging them to - even if it's just jotting down notes, bullet point your ideas instead of writing down numbers. I encountered a number of kids who just had a number written down, albeit the right answer, the right number. It's

like, it's all peer. When it comes time, I'll give it a [bad grade]. It's like, 'Really? Really?!' I told them that I'd be hard-pressed to do that. Part of being able to explain the work gets to, first organize your ideas, organize everything, and make sure everything is sequential. There's a logic behind it.

Whimbey et al. (2013) do not state that the problem solver use only dialogue to solve the problem. They explain that the problem solver both write and talk through the problem.

Larry did not continue to model with his class the strategy we developed together previously. Since Larry did not continue to model the strategy with his class, he could not relate the early modeling experience to his overall understanding of the task. Tharp and Gallimore (2002) explain that relating the early sub-goals of a training to the overall understanding of a task may result in confusion at early points in the developmental progression of the ZPD.

This school year was Larry's formal teacher evaluation. The vice principal was in charge of evaluating him. She had expressed how she does not like to see students sitting passively. One of the elements of having a formal teacher evaluation is that the principal will walk through the classroom unannounced and informally observe lessons. The formal observation component of the formal teacher evaluation, on the other hand, is planned. The teacher gives his or her lesson plan to the principal before being formally observed. Larry knows that the vice principal wants to see students interact, so he planned to have his math students share with one another during the formal observation. First, Larry had his students solve a math problem individually, then he had them pair-share. Once they had pair-shared, he had them get into groups of four to share how they solved the problem. Last, he had them share out to the whole group,

> LARRY: It was good for us to come together and have an overall class or group share
> out. They were able to see that, 'Oh, a number of other folks did it our way.' You were

affirmed. 'Then there were a bunch of people that did it another way, but you know what? They pretty much did it our way, but they represented it differently.' It was good for them to see how everything coalesced. I'm hoping that that's what [vice principal] will bring up. It's like, 'It was really good that you brought them together. I was just so [impressed].'

Although Larry has his math students share how they solved the problem, he leaves out the important role of the listener. Larry changed the structure of the TAPPS method so that the critical aspect of the TAPPS activity is missing where the listener asks the problem solver to evaluate his or her ideas so that the problem-solver can self-reflect. The problem solver then must evaluate his/her ideas in relation to the questions the listener asked. Larry made a point of students sharing their work with one another, but he did not assign roles. Throughout the PBL PD, Larry focused exclusively on a small portion of the capacity to be acquired. Larry did not progress past Stage 1 of his ZPD.

Case Study 3: Sandy

Introduction. Sandy started working at XYZ School as an instructional aide in 1983. She began her career as a teacher in 1987. She has been on the school staff the second longest out of everyone at XYZ School. The 2015-2016 school year was Sandy's first year teaching fifth grade. Before teaching fifth grade, Sandy had taught first grade for 18 years. Sandy does not participate on the school philosophy committee; however, she is involved with scheduling and sits in on Student Success Team and Student Success Plan meetings for XYZ School. These meetings are designed for parents and teachers to problem-solve collaboratively to find positive solutions to help the struggling student.

At the beginning of the school year, the fifth-grade teachers gave all fifth-grade students reading, writing, and math assessments so as to group students according to their ability. After we had graded the assessments, we found that we had a lot of mid-ability students in both reading and math. We decided, based on the assessment scores, SBAC scores, and fourth-grade teacher recommendations, to have two middle, one high, and one low ability math and reading classes. Since Sandy was new to fifth grade, we thought it would be less work for her to teach one mid-ability math and one mid-ability reading class. She could then share materials and follow along with me, the other math and reading mid-ability teacher. In reading, I emphasize that students create meaning through inquiry-based literature circles. Students in my reading class typically do not sit in rows facing the teacher but sit in small group circles around the room to have discussions based on the literature book each small group was reading. Both Sandy and I shared the same math and reading resources, instructional methods, and we tried to keep pace with one another.

Beliefs. Sandy's beliefs are associated with a contextualist worldview. Contextualists support a student based approach where students collaboratively construct shared understandings and teachers serve as facilitators (Schraw & Olafson, 2003). Sandy demonstrates her beliefs when she discusses Vignette 2 during our pre-PBL interview, "I like that they're encouraged to develop their own understanding." She also explains that "There's a little bit of each one of them [that I like] but I think I fall in the middle of 2 (contextualist) and 3 (relativist)." She describes how she does not agree with a realist view where the expert teacher transmits a "core body of knowledge" to the novice student, "I strongly disagree with [Vignette 1]. I mean, I agree with parts of it, but when it talks about how it's unlikely that students could really create this knowledge on their own. Disagree. I think I would just say disagree."

During our pre-PBL interview, Sandy wanted to tell me about a math PD that was very meaningful to her. After I was finished asking my interview questions, she asked if she could recount to me the PD that gave her permission to allow students to collaborate,

SANDY: I buy into the philosophy completely. That you could still have this philosophy and bring those elements of collaborative, problem-solving together, working, discussing, where you're just a supervisor. You're going around making sure that they're staying on task. Guiding them. Saying, 'wait, are you sure you're heading the right way? Are you sure there are four? You want to look at that again?' That's what I got out of those [professional developments], even though that [last] one was a math one, I think it's applicable to other areas.

Sandy establishes, through our discussion, that she supports peer interactions and teacher scaffolding through questioning, "I think I really started to use the word "why" more often with the kids. 'Why do you think that?'" Teachers with a contextualist worldview support scaffolded instruction and a structured curriculum while promoting student collaboration (Schraw & Olafson, 2003).

Themes. Three overall themes are presented for Sandy in Table 5. This researcher, during and after the coding process, identified important quotes made by Sandy. The researcher then placed the identified quotes into similar categories. The top three themes that emerged from the sorting process are also related to this study's research questions.

Table 5

Sandy Themes

Example Quotes	Theme	Frequency
"Forcing them to bring in that other part of the brain to utilize it; rather than 'it's just math.' I think it is sort of powerful."	Contextualist beliefs assist Sandy's movement through her ZPD.	16
"You can develop and find ways to help you think."	Higher order thinking tasks are an equally important goal for all students	13
"It's starting to take a bit more time because of the discussion, but I think the discussion is good."	Opportunities to develop a relationship between beliefs and teaching practice	23

"Forcing them to bring in that other part of the brain to utilize it; rather than 'it's just math.' I think it is sort of powerful." During our first PD meeting, we decided, for the SDL phase of our PBL process, to research activities that would help our students become better, as Larry describes it, "problem thinkers, critical solvers." Sandy, during her SDL phase, found books called Mind Benders which have deductive critical thinking puzzles in a story format. Sandy discusses her observations of her homeroom students collaborating over a Mind Benders story and asks us if that is what we are looking at possibly having all of our students do,

> SANDY: I've done a couple of them (Mind Benders) in homeroom. I have not done any in math. I would love to be able to pull [Mind Benders] in to do them at any time. [Students] would gather together and they were working off of each other, so I don't know if that's what we'd want (collaboration)?
>
> CARL: We can't stop them.

SANDY: They were sharing, 'No, I think this.' 'No, look at this.' It wasn't that way (she

replies in response to Carl, thinking he was making fun of student collaboration). I

thought it was good.

Sandy demonstrates her contextualist beliefs for social interactive learning (Schraw & Olafson,

2003) when she explains that her students' discussions were positive learning experiences. Later,

during PBL PD session 5, we discussed Whimbey et al. (2013) and "pair-sharing." Larry and

Carl make fun of pair-sharing. For example, Carl explains, "Yeah, my understanding, what we're

supposed to be doing. I do it all the time (stated facetiously), especially when I see you

(principal)." Whereas Sandy states she does pair-share regularly,

SANDY: It's funny you say that. I felt sort of self-conscious because [principal] came in

yesterday. It was during math and, darn, if she didn't walk in right when we [were about

to pair share]. We (class) had talked, and I was going to have them turn around and

actually [pair-share]. I do that quite often, and I thought, is she going to think -

CARL: Let her think it.

SANDY: that we're doing that just because she walked in. I feel like darn if I do, darn if I

don't.

Sandy used social interactive learning approaches to some degree in her classroom,

although, at first, Sandy has a limited understanding of the nature of the tasks discussed in the

Whimbey et al. (2013) book. Sandy demonstrates she is in Stage 1 of Tharp and Gallimore's

levels of ZPD (Tharp & Gallimore, 2002) when she tries to make meaning of the listener's role,

SANDY: Also, I think - what I see is too, is how the listener presents what they say.

That's another skill. How to say, not, 'Well, you made a mistake here.' In the book,

somewhere it said, you don't, you never give the answer but, I can't remember how they

said it, you point it out, 'What's your mistake here?' or 'Here, explain it to me.' How that's said is going to be -

CARL: As opposed to 'Wrong, loser' (pretending to be student).

SANDY: Right. The dynamics, attentive, knowing how to listen and knowing how to constructively question. I was going to say criticism but...

LARRY: Yeah, I think that's probably the most difficult part because it's hard enough for many adults to be able to do that, being tactful…

Tharp and Gallimore (2002) state understanding about a task is developed through assistance by more capable others. They explain that, at first, a learner's attention may be focused on a portion of the task to be acquired. Sandy exhibits her confusion later on in the same above conversation over her understanding of the TAPPS method. She assumes students explain what they already simply know as opposed to explaining how they solved a problem,

SANDY: What's also harder, my thought, with the older kids, in doing this. In first grade, you could do this (explain how they solved the problem) and they would - they're more, 'okay, yeah we can do that.' In the older kids, it's like they sort of think they know it and they're not sure what you're [wanting from them], like 'I know that, why are you explaining that I added the 4+3? I knew that.' A lot of the times I'm like, 'but then you just.pretend, when it says explain, just pretend that I really don't know. You've got to start from the very beginning, how would you lead me through? How would you tell me?'

Here, Sandy needs scaffolding and encouragement to help support her development and understanding of the TAPPS method,

MICHAELA: I think that [TAPPS] would work with [Sandy's problem], the goal of the listener working with a partner. You need to explain [to your students], "this is the purpose of why we're doing this activity." I notice students understand when I say there's a purpose behind why we're doing an activity. [For example], it is because you are going to become, hopefully, better problem solvers. Telling them that [their] role as a listener is that [they're] going to continually check for accuracy, and then, what you brought up, Sandy (in previous conversation of not telling the student the answer but asking questions). When you, [as the listener], catch an error, point it out, but allow the problem solver to go back and think about it. Also, demanding constant vocalization when the problem solver starts getting quiet. Then you [as the listener] have to say [to the problem solver], "you need to talk it out." [My students] are good at that. When I did a teach - you know, [where one student is] the teacher [the other is a student, and then they switch roles], they can do it. I don't know about as in depth as the [TAPPS method], but they do talk, and one partner [actively] listens.

Sandy also relies on the Whimbey et al. (2013) book to help scaffold her learning. She discusses the importance of modeling how to be a listener to her students,

SANDY: I think you're right, it's not going to be an [easy process], but if you can sort of sow that seed of the modeling, and again, just modeling and modeling. There's going to be a point, I think, [where they will understand].

Not only do Whimbey et al. (2013) describe the importance of modeling the TAPPS method, but Tharp and Gallimore (2002) also describe modeling as "a powerful means of assisting performance, one that continues its effectiveness into adult years" (p. 49). Sandy begins to achieve intersubjectivity with the book as she starts to regularly use the strategies that Whimbey

et al. (2013) describe in their book (Table 8). We see evidence of her intersubjectivity when she outlines the benefits of using the Whimbey et al. (2013) TAPPS method,

> SANDY: When you are thinking about it, it's one thing. But when you are talking about it, you are engaging a whole different section of the brain that comes into play. It is a dual process. I am saying it is two things in the slowing down (we discussed earlier how students cannot rush to solve a problem when students have to discuss the problem too), but it is also kicking in, and I don't know how else to explain. It is a little oomph from another part of the brain that they are getting feedback for.

Sandy becomes increasingly self-supported, and begins to engage her students in the TAPPS method without assistance from others. Her move to Tharp and Gallimore's (2002) Stage 2 where performance is assisted by the self is demonstrated with the following statement,

> SANDY: Yeah. Somewhat successful [with problem-solving]. I think we need some tweaking on it and again it is the pacing. I try to put it in if we have a few minutes. "How about we look at this and explain it and-." It is not consistent, but I think we are headed in a good path. It still needs some work.

Sandy's use of social interactive learning approaches for all academic subjects is approaching Tharp and Gallimore's (2002) Stage 3. She describes how she believes that student interactions are meaningful for learning, "Forcing them to bring in that other part of the brain to utilize it; rather than 'it's just math.' I think it is sort of powerful." However, Whimbey et al. (2013) state that problem-solving using the TAPPS method should be used daily. Sandy claimed that using the TAPPS method daily was difficult because of the limited amount of time we have to teach math. XYZ School adopted a new math textbook and we did not know if we were pacing

ourselves correctly to complete all the lessons in time for California state testing. Sandy is also new to fifth-grade math,

> SANDY: The next year towards math I will have, at least being new, I'm feeling a little bit more, better about the math and what's to come, and how better to integrate it [using the TAPPS method. Now, at least, [I]'ve gone through it once, and so I think, maybe, I hope I could integrate it a little better. [It was hard,] coming in cold turkey [this year].

"You can develop and find ways to help you think." Sandy provides evidence that she believes that all her students, regardless of ability, benefit from a higher order thinking curriculum. Her beliefs that all her students benefit are evident when she discusses her use of critical thinking activities with her mixed ability homeroom class, "I've done a couple of them in homeroom. I have not done any in math. I would love to be able to pull them in to do them at any time." Later in the conversation, she describes how she had a few students in her homeroom who struggled,

> SANDY: I had them check their own work. A few are still missing out (not understanding the task). They're not able [to solve], and so we go back and talk about, 'What were the words that you used,' and once they're talking about it, they seem to be able to focus in. But on their own, they're still having a little difficulty. Not all of them. It's just a few.

Here she demonstrates her beliefs that it is advantageous for those few struggling students to discuss the problem with one another. She scaffolds their learning by having the struggling students discuss with their peers how to work through the problem. She notes that they cannot achieve the tasks by themselves and she sees the value of social interaction for helping struggling students construct knowledge. Her students are active both in their peer discussions and whole-

class instruction. In addition, teachers with a contextualist epistemology tend to use discourse strategies that differ from teachers with realist epistemology. Sandy values student discussions, peer interactions, and problem-solving in her classroom.

During our discussion around Whimbey's (1989) sentence ordering activity taken from his *Analytical Reading & Reasoning* book, Sandy thoughtfully responds to Larry about his claim of why the low students struggled,

LARRY: There's an element of laziness in them.

SANDY: I mean, they were pretty darn sure they were right by saying, 'Yes, because that's [the] first [sentence].' It wasn't that they hadn't tried. It was "first" is first. No, I don't think it's laziness, and some [students solved it] fast. But, even in that point, no, it wasn't like they wanted to get done. It was "first" and then the other two [sentences] somehow have just got to fit in.

Larry continues to demonstrate his belief that low-achieving students have a preference for easy work. In contrast, Sandy does not appear to believe that her low-achieving students deliberately chose to not complete the task. In addition to valuing social interaction to construct knowledge for her struggling students, Sandy mentions modeling many times throughout the PDs to help students understand the role of the listener, "Because I think they don't - they think listening is sitting there. I think we have to actively model what do you do as a listener." She is aware that working through the problems are engaging for her learners. During our last PD discussion, she states, "I would like to do another [collaborative math performance task] too because, first of all, they seem to enjoy them. It's a fun way for them to do it." She believes that the collaborative performance tasks we were discussing are engaging for her math students, therefore they are a valuable activity. Overall, Sandy sees all of her students as capable, not only

her higher-achieving students, of engaging in a higher order thinking curriculum. Sandy bases her instructional decisions on her constructivist/contextualist beliefs of how children learn and what they need to learn.

"It's starting to take a bit more time because of the discussion, but I think the discussion is good." Tharp and Gallimore (2002) explain that conversation is a key factor for developing understanding in a teacher's ZPD. Once an understanding has been developed, peers can further develop the teacher's intersubjectivity through questioning, feedback, and cognitive structuring. During one of our PDs, Carl describes how he is "prescriptive" (structured) in his teaching and that it works for his students. Sandy responds to Carl, reflecting on her first-grade teaching experience where she felt that a transmission approach could be an obstacle to student learning,

> SANDY: You know, between us, I can only draw from first grade, but in first grade, and let me say in "lock step," we're in there saying [to our students], 'These are the [words to use], when you see this' because we're trying to teach [prescriptively]. It's the same way when we're doing our power writing. We're teaching them a- a- in a way-
>
> CARL: It's really good.
>
> SANDY: Well, right, but in a way, then coming up (students moving through different grades), it's - I don't want to say a hindrance, but they're - but in first grade, it's - 'Okay, these are subtraction. When you see these, you got to remember, this is what you do,' because they're very simple [math problems].
>
> CARL: It's very, very, very effective.

When Sandy tries to make meaning of her experiences and explain how the lack of higher order thinking curriculum could be a handicap, Carl does not reflect on what she is saying but

responds that a direct transmission approach is powerful for primary students. Another instance where Sandy was describing to us how her first modeling lesson went and how her students wanted to enthusiastically participate instead of listening, Larry chooses not to respond to her concern of managing her students' enthusiasm,

> SANDY: When we started it, I told my students, [I will] model thinking out loud, and I had them put their pencils away. But their hand would go up when I'd go, 'Oh, I think…' They had a hard time of just listening. They wanted to participate. I want hands to go down. Multiple times I said, 'Guys, no. This is just, I'm modeling it.' And they had a hard time not being able to do that (listen).

> LARRY: There's some kids when you tell them that you're modeling something, they want something that's really prescriptive. They feel more comfortable when it's really highly structured. They almost want to take down notes, like how is Ms. Sandy doing this. Because when she tells us it's our time to think out loud it's like - I mean even down to the words that she might use. For some kids, it's that.

Here, she needs scaffolding on how to manage social interactive learning experiences, but instead of responding to this need, she is told by Larry to be more "prescriptive" because that is what he explains her students actually want from her. However, what Sandy is describing does not appear to be her students wanting more "prescriptive" talk, but more interaction and active learning.

Since Sandy was new to the grade level, she was advised to plan her reading instruction with me since we both had the mid-ability reading class. I gave her instructional materials and had her class observe and participate in my reading students' literature circle conversations. Literature circles use a constructivist learning approach where students develop questions to ask

their literature circle group members and respond to each other reflections. Sandy was engaged

in a constructivist learning approach for her reading class, and we had conversations on how to

manage these social interactive learning experiences which helped her develop intersubjectivity

with a more constructivist approach to learning.

In addition, the principal and especially the vice principal of XYZ School expect the use

of pair-share in the classroom. Sandy had already adopted the pair-share collaborative learning

strategy as an instructional strategy, which is an approach based on social constructivist learning

theory. Sandy explains an instance where the principal walked in, and she knew the principal

was looking for pair-share interactions among her students. She goes on to explain that she does

have her students "pair-share" regularly and did not like that the principal may believe that she

was only asking her students to interact because she walked in,

> CARL: Yeah, my understanding, what we're supposed to be doing. I do it all the time,
>
> especially when I see you.
>
> SANDY: It had nothing to do with that.

Sandy's regular use of the pair-share strategy as opposed to only using it when the

principals walk into her classroom also contributed to her developing a relationship between her

contextualist beliefs and her teaching practice. During our second to last PBL PD meeting, Sandy

discusses her growing intersubjectivity with the importance of students engaging in dialogue

with one another to stimulate learning,

> SANDY: You don't realize that talking about it or explaining it is part of math because it
>
> is words. It doesn't mean a lot (XYZ School does not typically value discussion in math).
>
> CARL: That is what we are getting at. That is what this problem-solving thing is.

SANDY: Right. That is why I think just getting them to stop and talk. If you could just get them to stop and talk. Maybe fewer problems.

CARL: I am for that. I think the more problems you give in number at a time, the more you emphasize getting the right answer and getting done.

SANDY: Right. Just that one little part of it the brain. It is getting a good workout.

Sandy's experience is positive as evidenced by the following statement, "Forcing them to bring in that other part of the brain to utilize it; rather than 'it's just math.' I think it is sort of powerful." Sandy, through our conversations, the Whimbey et al. (2013) book, cognitive structuring, pressure from the principals because she was being evaluated, and most importantly, her witnessing the positive effects student dialogue had on her students' learning helped her develop her classroom instruction to align more with her contextualist beliefs.

Schraw and Olafson's (2002) Adapted World View Vignettes

Schraw and Olafson's (2002) Adapted World View Vignettes were presented to the participants before the PBL PD sessions started and then again after we had concluded the PBL PD sessions. There were not significant changes between pre and post responses to the vignettes (Table 6). The biggest change was with Larry's post PBL PD response to Vignette 3. Vignette 3 is aligned with a relativist worldview. During the pre PBL PD interview Larry states, "There is a time and place for this, but I think you have to be an advanced thinker to tread this. In many ways, I would not introduce this to my kids." However, during our post PBL PD session, Larry explains that there are instances of when it would be appropriate for him to use the Vignette 3 worldview,

LARRY: That certainly comes into play when you deal with something like social studies. Where it is much more open to interpretation, and when we talk about right

versus wrong and things like that. Some of the things dealing with the actions of people in the past. 'What would you have done in the situation? How different was it then compared to now?' That deals with their values, and again I would agree with that. I'd be wary of Vignette 3 if you, or any of these vignettes for that matter, if you try to simply apply them across the board. If you forced me to choose one, I probably would lean toward Vignettes one and two, probably an amalgam of those two.

Table 6

Participant Responses to Schraw and Olafson's (2002) Adapted World View Vignettes

Worldviews	Carl	Larry	Sandy
Pre-PD Vignette 1 Realist Worldview	Agree	Between Strongly Agree and Agree	Disagree
Post-PD Vignette 1 Realist Worldview	Agree	Strongly Agree	Neutral
Pre-PD Vignette 2 Contextualist Worldview	Neutral	Agree	Agree
Post-PD Vignette 2 Contextualist Worldview	Neutral	Agree	Agree
Pre-PD Vignette 3 Relativist Worldview	Neutral	Between Neutral and Disagree	Agree
Post-PD Vignette 3 Relativist Worldview	Disagree	Agree*	Agree

* Because of his consideration of social studies knowledge as different from mathematics

When asked to relook at the vignettes during the post PBL PD interview, Carl groans and says, "Turn [the recorder] off while I complain for a while." He then states, "Nothing has changed. Where's my other one?" However, Carl does change his response to Vignette 3 based on an experience he has with some of his math students. Carl's original pre PBL PD response to Vignette 3 was,

CARL: Again, at 10, I don't feel it's the most efficient way to do it. I don't want to just go, 'Well, I don't care.' That's how I interpret neutral. I interpret neutral as like, whatever, kind of, where I think it's got its place, and perhaps ever-increasing things. When you get to an upper-division college course or a seminar or something, you'd want to be able to do that (Vignette 3).

Carl interprets "neutral" as to mean that eventually as students get older they will be able to engage in Vignette 3 learning, but it is not appropriate at age 10. He later changes his response to Vignette 3 during our post PBL PD session to "disagree" because of an experience he had with his math students, although it still aligns with his original response that Vignette 3 is not appropriate for 10 year olds,

CARL: It's because it's elementary school. I really think that's one of the things that makes us so efficient here (XYZ School). Some of these things are truths, they're not ... When the boys tried to invent a new way to add fractions the other day, I mean, it was a dismal failure. Because this is how you do it and that way doesn't work. You know, and this is a sentence and that kind of thing. So, certain things, and I'm open to change, we can call Pluto a dwarf planet, I don't have a problem with that and the science book doesn't say that but okay. But ultimately, this, you need to get. This, you need to be able to do.

Sandy states during the pre PBL PD interview that she disagrees with Vignette 1, which aligns with a more realist worldview,

SANDY: I strongly disagree with it. I mean, I agree with parts of it but when it gets down and talks about it's unlikely that students could really create this knowledge on their own. Disagree. I think I would just say disagree.

Sandy changes her response to "neutral" during the post PBL PD interview,

> SANDY: I just don't like [Vignette 1], so I'm sort of neutral on that. I don't like when it says "through an expert," and I know I'm the teacher, I have a much better sense of what they do, of what is important to learn. "It is unlikely that students could really create this knowledge." [Don't agree]. But [Vignette 1] went back to say "core knowledge," so that's why I'm sort of neutral.

Adapted teacher's beliefs questionnaire. The participants also individually filled out a paper questionnaire (see Appendix I for questions) at the end of the PBL PD sessions. Statements 1, 4, 5, and 6 align with a contextualist view of learning, whereas statements 2, 3, 7, and 8 align with a realist view of learning (Appendix L). The scale used for the questionnaire was a five-point scale that measured attitude on how much participants agreed or disagreed with a particular statement. Each of the responses corresponded with a numerical value with 1 correlating with strongly disagree, 3 being neutral, and 5 correlating with strongly agree. Table 7 shows the mean for each participant's constructivist and transmissionist epistemological view. The two strongest rated statements (Appendix L) by participants, statements 1 and 6, are also aligned with the focus of our PBL PD, "How can we help our students become better problem solvers?"

Table 7

Mean for Constructivist Statements vs. Transmissionist Statements

Particpants	Constructivist Responses (Mean)	Transmissionist Responses (Mean)
Carl	3.5	3.25
Larry	3.625	3.125
Sandy	4.5	2.5

5-point rating scale: Strongly Disagree   Strongly Agree

                                    1   2   3   4   5

Cross-Case Analysis

The cross-case analysis section first discusses the procedures used for examining the themes across cases. It then summarizes the results from each of the individual cases. Next, this section compares and contrasts Carl, Larry, and Sandy's responses to the vignettes and then the questionnaire. Last, the themes across cases are presented.

The cross-case analysis of the three participants was similar to the same procedures used for examining the themes across cases. This analysis, however, involved integrating the findings to see the similarities and differences in each of the cases. The analysis also relied on a thick description in order to get a better understanding across cases. The cross-case analysis suggested that three themes were consistent across the three teachers who participated in the study. These themes are the role of Teacher's Beliefs about Student Ability, Teacher Intersubjectivity of the Learning Goal, and Unplanned Events Cause Teachers to Revert Back to Beliefs and Shift Collective Goals. For each of the themes, quotes were used to give a sense of how the teacher expressed the theme. This serves to highlight the ways which each of the cases share similarities and differences.

Carl's beliefs align with a transmissionist epistemology, which is the belief that knowledge is transmittable, linear, simple, innate, and specific (Howard et al., 2000). Carl states during the pre and post PD interviews that he prefers Vignette 1 (Appendix A). Vignette 1 aligns with the belief that there is a core body of knowledge that is learned by transmission from the expert teacher to the novice student. After the PBL PD, Carl took the Johnston et al.'s (2001) Adapted Teacher's Beliefs Questionnaire. Though three of the four of Carl's highest ratings on the Adapted Teacher's Beliefs Questionnaire aligned with a constructivist epistemology, Carl explains during the PBL PD interviews that he believes constructivist approaches are more

appropriate for college-aged students and during the PBL PD he repeatedly discussed how his

students were low ability and not capable of learning in a constructivist environment. Carl had

difficulty developing intersubjectivity with the premise of the TAPPS method (Whimbey et al.,

2013) that problem-solving is best discerned through discussion in a social context where the

learner must self-reflect on his or her thought processes. Larry, who had similar beliefs to Carl,

supported Carl's transmissionist beliefs. His support was a barrier for Carl making sense of the

constructivist ideas that were presented in the Problem Solving and Comprehension (Whimbey et

al., 2013) book and our discussions. Carl maintained that his low ability math students were

incapable of engaging in the TAPPS method (Whimbey et al., 2013) since it requires higher

order thinking skills. Carl seemed to need more support than he was receiving from the book,

Sandy, and this researcher. Carl remained in stage 1 (Table 8) of his progression through his

ZPD.

Larry's beliefs are aligned with a transmissionist epistemology, which is the belief that

knowledge is transmittable, linear, simple, innate, and specific (Howard et al., 2000). During

both the pre and post PD interviews, Larry stated that he strongly agrees with Vignette 1.

Vignette 1 is associated with a realist worldview and related to transmissionist teaching

practices.

After the PBL PD, Larry responded to the Johnston et al.'s (2001) Adapted Teacher's

Beliefs Questionnaire. The mean of Larry's constructivist statements versus his transmissionist

statements are presented in Table 7. Though there was a only slight difference between his

constructivist statements versus his transmissionist statements, this was explained when Larry

described that certain approaches are more appropriate for teaching specific subject areas, such

as using an constructivist approach to teach social studies. Larry had deep misconceptions about

the importance of the role of the questioner/listener. He had poor prior experiences of the role when a math trainer modeled things in an incorrect way. During the PBL PD, he struggled with developing intersubjectivity with the book's (Whimbey et al., 2013) premise that the role of the questioner/listener is needed for problem-solving and self-reflection. Larry stated multiple time that he believed Carl's low ability math students were incapable of engaging in the TAPPS method (Whimbey et al., 2013). Larry had pressure from the principal and vice principal of XYZ School to have his students engage in peer discussions. However, since the goals of our PBL PD task were not shared with the administrators, they did not encourage his learning and putting the goals of the PD into practice. Larry remained in stage 1 (Table 8) of his progression through his ZPD.

Sandy's beliefs align with a constructivist epistemology, which is the belief that knowledge is complex, subject to change, learned gradually, and is constructed by the learner (Howard et al., 2000). Constructivist's support a student based approach where students collaboratively construct shared understandings and teachers serve as facilitators (Schraw & Olafson, 2003). During her pre and post PBL PD interviews, Sandy states her preference for Vignettes 2 and 3. Vignettes 2 (contextualist) and 3 (relativist) are associated with constructivist beliefs. After the PBL PD, Sandy took the Johnston et al.'s (2001) Adapted Teacher's Beliefs Questionnaire. The mean of her constructivist statements versus her transmissionist statements are presented in Table 7. There is a 2 point difference between the mean of her constructivist statements versus her transmissionist statements. The difference indicates she has a preference for constructivist beliefs. All of her Agree and Strongly Agree ratings were correlated with Constructed Knowing (constructivist) characteristics. Her Strongly Agree ratings aligned with the premise of the TAPPS method (Whimbey et al., 2013) that problem-solving is best learned

through student discussion and self-reflection. Sandy incorporated constructivist ideas and

strategies into her daily teaching practice while the PBL PD took place at XYZ School. Sandy

believed that all of her students were capable of engaging in higher order thinking skills and the

TAPPS approach to problem-solving. XYZ School administrators also supported Sandy's

constructivist teaching methods in the classroom. Sandy began the PBL PD at stage 1 and

progressed through her ZPD to approach Stage 3 (Table 8) of her ZPD.

Table 8

Participant's Stage of Proximal Development by End of PBL PD

Participants	Stage 1 Assistance is provided by more capable others	Stage 2 Assistance is provided by the self	Stage 3 Internalization and automaticity
Carl	Resists the problem-solving method provided by the book* and the facilitator. Does not reach intersubjectivity of the learning goal.	n/a	n/a
Larry	Resists the problem-solving method provided by the book* and the facilitator. Does not reach intersubjectivity of the learning goal.	n/a	n/a
Sandy	Works with assistance. Adopts the method provided by the book* and accepts assistance provided by the facilitator.	Adopts the constructivist ideals from the book* across different subject areas. Assists herself by using a variety of stage 2 approaches.	Is capable of managing the task on her own. Uses constructivist ideals regularly.

Problem Solving & Comprehension (Whimbey et al., 2013).

Cross-Case Analysis of Schraw and Olafson's (2002) Adapted World View Vignettes

Schraw and Olafson's (2002) Adapted World View Vignettes (Appendix A) were used

during the pre and post PBL PD interviews. As discussed earlier, the adapted instrument (Schraw

& Olafson, 2003) was used as a format for participants to discuss their epistemological beliefs.

Each participant was asked to read and then respond to the realist, contextualist, and relativist

vignette summaries (Schraw, 2013; Schraw & Olafson, 2003). They rated each vignette

summary on which they agreed on a 5-point scale ranging from strongly disagree (1) to strongly

agree (5; Table 9). A realist worldview is associated with transmissionist beliefs about

knowledge, while contextualist and relativist worldviews are associated with more constructivist

beliefs.

Table 9

Pre and Post PBL PD Interview Responses to Schraw and Olafson's (2002) Adapted World View Vignettes

Participants	Pre to Post Realist/ Transmissionist Change	Pre to Post Contextualist/ Constructivism Change	Pre to Post Relativist/ Constructivism Change
Carl	No change Agreement (4-4)	No change Neutral (3-3)	Slight decrease Neutral to Disagree (3-2)
Larry	Slight increase Strongly agree (4.5-5)	No change Agreement (4-4)	Increase Disagree to Agree* (2.5-4)
Sandy	Slight increase Disagree to Neutral (2-3)	No change Agreement (4-4)	No change Agreement (4-4)

5-point rating scale: Strongly Disagree   Strongly Agree
                                    1   2   3   4   5
* Due to Larry's belief that knowledge should be treated differently in specific domains e.g., mathematics versus social studies

        Carl and Larry responded similarly to the realist/transmissionist vignette summary (Table

9) with Larry's post-PBL PD response resulting in strongly agree. Their responses demonstrate

how similar their beliefs were to one another. Throughout the PBL PD, Carl and Larry formed an

alliance and supported each other's transmissionist epistemological beliefs.

Larry's post-PBL PD constructivist (contextualist and relativist) vignette summary responses also aligned with Sandy's post constructivist responses, which do not align with his beliefs on how people learn. In the interview discussion, he stated how he responded to how each vignette summary and discussed how the vignettes aligned with a situation or subject such as social studies, but he differs from Sandy in that he did not believe this constructivist approach vignette was true for a subject like mathematics.

> LARRY: I do agree. I think for this there is definitely a place for it. It may seem as if it runs contradictory to my feelings about vignette 1, but again, depending on the subject area, this is equally valued.

When comparing Carl, Larry, and Sandy's vignette responses on the pre and post realist/transmissionist vignette summary, Sandy's views are in contrast to both Larry and Carl's realist/transmissionist views. Both Carl and Larry believe that constructivist approaches to learning may be appropriate for certain subject areas or for older learners, and that transmissionist approaches to learning are best for younger learners. Sandy believes that,

> SANDY: I strongly disagree with [Vignette 1]. I mean, I agree with parts of it, but when it talks about how it's unlikely that students could really create this knowledge on their own. Disagree. I think I would just say disagree.

Carl and Larry both stayed in stage 1 of their ZPDs as compared to Sandy who progressed to stage 3 of her ZPD.

Cross-Case Analysis of the Adapted Teacher's Beliefs Questionnaire

The participants also individually filled out a paper questionnaire (Appendix I) at the end of the PBL PD sessions. Statements 1, 4, 5, and 6 (Appendix L) align with a contextualist view of learning, as compared to statements 2, 3, 7, and 8 which align with a realist view of learning.

Table 7 shows the mean for each participant's constructivist and transmissionist responses. Carl and Larry's constructivist and transmissionist responses are very similar to one another. Their similar responses are characteristic of the relationship they had throughout the PBL PD. Carl and Larry supported each other and developed their own shared understanding of the Whimbey et al. (2013) task based on their transmissionist epistemology. They both stayed in stage 1 (Table 8) of their ZPDs. However, Sandy's constructivist versus transmissionist responses, when compared to Carl and Larry's responses, demonstrate how her beliefs differ from both Carl and Larry. Sandy, as opposed to Carl and Larry, was able to move through her ZPD to stage 3.

Cross-Case Analysis of Themes

In this next section, themes uncovered in the analysis of the transcripts of conversations were compared across cases for similarities and differences.

Cross-case teacher's beliefs about student ability. Teachers' beliefs about their math students' academic abilities determined how they implemented the Whimbey et al. (2013) strategies. Both Carl and Larry believe that XYZ School's low achieving students do not have the capability of engaging in higher order thinking tasks, such as the TAPPS method. Carl states that his low-achieving students are aware that they cannot engage in higher order thinking, "My kids, the lower kids, are at least aware that this is an issue with them." Larry supports the view that low achieving students need basic skills instruction when he explains that Carl's math lessons need to "be extremely prescriptive," albeit it will "seem like drudgery." Carl veered from the Whimbey et al. TAPPS method that we decided on as a group to use, and had his students solve the problem by themselves at home.

On the other hand, both Carl and Larry believe that XYZ School's higher achieving students are ready for higher order thinking tasks and are capable of engaging in the TAPPS

method. Carl demonstrates his beliefs with the following statement, "Well, you want to probably do it (problem solve daily) as much as possible. I don't know that I'm set up to do it daily. We have so much trouble coming into class and getting our stuff out to correct." Larry, who has the higher achieving math students believes that his students can engage in higher order thinking tasks, "I probably have, of the four of us, it's probably easiest for me to do things in math because I can get those kids like, all right, slow down, we can do this." However, Larry's misconceptions about the importance of the role of the questioner/listener prevented him from understanding the purpose of the TAPPS method.

Sandy, on the contrary, believes her students are capable learners and that higher order thinking tasks are meaningful for learning, "When you are thinking about it, it's one thing, but when you are talking about it, you are engaging a whole different section of the brain that comes into play. It is a dual process…It is a little oomph from another part of the brain that they are getting feedback for." Sandy never draws a distinction between low achieving and high achieving students during our discussions. For example, she points out that some of her mixed ability homeroom students had difficulty with a Whimbey (1989) task. Instead of assuming that the students who were struggling (her lower-achieving students), need more simplistic basic skills instruction, she explains they need more scaffolding from peers, "A few are still missing out (not understanding the task). They're not able [to solve], and so we go back and talk… and once they're talking about it, they seem to be able to focus in. But on their own, they're still having a little difficulty. Not all of them. It's just a few." Sandy chooses to have all of her students actively engaged with one another so that they can construct meaning through their peer interactions. For her struggling students, Sandy offered guidance and peer support as opposed to opting for a passive direct instruction approach to learning. Contextualists, in contrast to realists,

believe that students actively construct knowledge in collaboration with the teacher and other students (Schraw & Olafson, 2003). Sandy sees all her students as capable of engaging in higher order thinking instruction.

Teacher intersubjectivity of the learning goal. According to Tharp and Gallimore (2002), teachers must develop a common understanding or "intersubjectivity" (p. 89) of the learning goal to be achieved. Matusov and Hayes (2000), in his review of the research on intersubjectivity, states that having a shared goal is an essential requirement of the teaching-learning situation. Scaffolding or assistance can only occur when there is a shared understanding among the participants. When intersubjectivity is absent, learning conflict, lack of participation, and unplanned outcomes may occur (Dennen & Burner, 2008).

To summarize the earlier information about PBL PD: The learning goal that we as a group decided to focus on was, "How can we help our students become better problem solvers?" Carl highly recommended activities developed by Dr. Whimbey. Both Carl and Larry describe how a former highly respected principal at XYZ School and a champion of the traditional, back to basic philosophy of the school, "was a big-time advocate" of Whimbey. At our second PBL PD meeting, Carl states, "Our boy, Whimbey's, got a certain thing, think aloud, pair thing, that you do." Carl did some research and found a book by Whimbey et al. (2013), called *Problem Solving and Comprehension.* We decided to use this book to help us answer our PBL question.

When Carl and Larry struggled with using the strategies that Whimbey et al. (2013) describe for effective problem-solving, they both would give feedback to one another that was contradictory to Whimbey et al.'s description of the task.

CARL: Oh, I'm the listener, that means I don't have to do anything.

LARRY: Yeah, until it's my turn to share, and then it's just an empty exercise. You share, I share, we're done.

Larry and Carl supported each other's realist views and downplayed the role of peers throughout the PDs instead of assisting one another with developing Whimbey et al.'s (2013) strategies for effective problem-solving. They both perceived the listener portion of the Whimbey et al. (2013) TAPPS method as unnecessary for developing problem-solving skills and therefore irrelevant to their goals. The purpose of the listener's role is to help the problem solver verbalize his or her thought patterns so that he or she can self-reflect, which is a key feature of the TAPPS method. They only completed a portion of the task as described by Whimbey et al. (2013) because they had developed their own shared understanding of successful problem-solving. Their understanding of problem-solving was based on their traditional beliefs that learning is linear and based on specific procedures to be followed. Scaffolding requires that participants have a shared understanding of the goal of the activity. Carl and Larry accepted limited scaffolding assistance and did not fully accept Whimbey et al.'s (2013) strategies for problem-solving. They, had difficulty moving past Stage 1 of their progression through the ZPD.

In the beginning of our PBL PD discussions, Sandy had a limited understanding of the Whimbey et al. (2013) TAPPS method. However, she gradually began to understand the meaning of the Whimbey et al. (2013) activity and how the parts of the activity relate to one another. Our first goal we developed as a group was to create a script that we all used to model problem-solving to our students. Sandy struggled somewhat with the lesson,

SANDY: When we started it, I told my students, [I will] model thinking out loud, and I had them put their pencils away. But their hand would go up when I'd go, 'Oh, I think…' They had a hard time of just listening. They wanted to participate. I want hands to go

down. Multiple times I said, 'Guys, no. This is just, I'm modeling it.' And they had a hard time not being able to do that (to listen).

Her students were also in Stage 1 of the learning process and needed assistance with the listener role. Sandy used the Whimbey et al. (2013) book to scaffold her learning. Whimbey et al. (2013) describe the importance of using modeling as a strategy to assist performance. Sandy discussed the use of modeling the role of the listener frequently with her students,

SANDY: I think you're right, it's not going to be an [easy process], but if you can sort of sow that seed of the modeling, and again, just modeling and modeling. There's going to be a point, I think, [where they will understand].

In addition to her learning how to use the TAPPS method, Sandy was also involved in learning how to conduct literature circles with her reading class. Literature circles use a constructivist approach to learning where students come together to listen to group members' reflections and engage in thoughtful dialogue. Sandy's use of literature circles helped her develop a shared understanding with a more constructivist or social interactive approach to learning. Moreover, Sandy embraced the think-pair-share instructional strategy in her classroom which is based on social constructivist learning theory. The principal and the vice principal of XYZ School supported Sandy's use of think-pair-share and they offered social reinforcements of encouragement. Sandy additionally experienced success when she observed her students' interactions as positive. She states, "I think it is sort of powerful" when she describes her students using the TAPPS method. Although Sandy began the PD with a limited understanding of the TAPPS method, she began to acquire a conception of the overall TAPPS activity because she was engaged in constructivist methods throughout her instructional day. Sandy developed a common understanding of the learning goal to be achieved as her contextualist beliefs were

supported by the principal, the vice principal, and her positive experiences. Since Sandy was able to develop a common understanding of the goal to be achieved, she was able to move through Stage 1 and 2, and slowly approach Stage 3 of her ZPD.

Unplanned events cause teachers to revert back to beliefs and shift collective goals. A brief summary of the PBL PD: Carl, Larry, Sandy, and I collaboratively decided that our PBL PD learning goal was, "How can we help our students become better problem solvers?" Based on Carl's strong recommendations for using activities designed by Dr. Whimbey, our group decided to use *Problem Solving and Comprehension* by Whimbey et al. (2013) to help us answer our question. Since Whimbey et al. (2013) state the importance of modeling problem-solving strategies, we agreed to develop a script together to model our problem-solving strategies to our math students. Our collective goal was to model the script and strategies for our students, then give our math students two similar math problems so that they could practice the TAPPS method which Whimbey et al. (2013) state is essential for developing problem-solving skills. Carl, when he implemented the lesson, struggled when a student in his math class did not respond according to his plan,

> CARL: I was having a dialogue with four people and Marsha said, 'Why isn't it,' and she gave the answer (solution to the math problem). I said, 'That's interesting, but that's not what the listener is supposed to be doing.'

Carl shifts our collective goal of modeling and having students take turns with the listener and problem solver roles and explains,

> CARL: I said, 'I just [modeled how to problem solve using my script] with you, as a class. I want you to go home, and I want you to write [your own] script.' … I decided to do that because I thought a lot of these cats, they're skipping stuff. If they did it out loud

it would be a mess. So I said, 'You know what? I want you to do what we did [just now], which is write out step-by-step this is what I did [to solve homework problem].' I had to spend a lot of time trying to overcome what I perceived to be a bunch of people going, 'I don't need to do this,' or, 'This is just another thing,' or 'whatever,' or, 'This is silly,' or, 'This is an opportunity for me to not do anything,' or whatever they think. The myriad of reasons that they have for not paying attention, or whatever.

When Carl's original goal of his math students collaborating using the TAPPS method did not go as planned, Carl, in the moment, quickly responded to this unplanned event by creating a goal more in line with his beliefs. He asked his students to write step by step how they individually solved the problem instead of discussing the problem using the TAPPS method (he called this a script). Although Carl wanted to make a change in his pedagogy and advocated for the Whimbey et al. (2013) strategy, "Our boy, Whimbey's got a certain thing, think aloud-pair thing, that you do," he quickly reverted to his long-held realist beliefs.

Larry demonstrates his beliefs during the following monologue,

LARRY: Really, even from my group, we need more time, more practice, more opportunities to deal with questioning. Practicing being a good listener and then having good feedback, a critique, that's difficult enough for adults. Now you're asking a 10-year-old to do it, that's perhaps impossible. Based on everything I've observed. I know that the kids definitely have a much better idea in terms of how to show work. I think it's not a surprise to me either that unless there are clear consequences laid out, in terms of, 'Well, I need to see all your work written down,' they're not going to do that. They want to just talk it out. When I look at their papers, just the number there. I was really encouraging them to - even if it's just jotting down notes, bullet point your ideas instead of writing

down numbers. I encountered a number of kids who just had a number written down, albeit the right answer, the right number. It's like, it's all peer. When it comes time, I'll give it a [bad grade] It's like, 'Really? Really?!' I told them that I'd be hard pressed to do that. Part of being able to explain the work gets to first organize your ideas, organize everything and make sure everything is sequential, there's a logic behind it. I think that if the kids knew that it was being graded, or that it had consequences. This is going to determine where you'll be placed next year. I bet you everything will be neatly laid out, but on a regular basis. Meh.

Larry begins the discussion by explaining that he does not believe that ten year olds are capable of taking on the listener role. He does say that his students are better at showing their work, but then he transitions and states that when they are working collaboratively they do not write down their problem-solving steps. Larry blames his students lack of writing down their steps for solving the math problem on their peer discussions, "It's like, it's all peer." The TAPPS method requires that the problem solver write down and explain step by step his or her strategy for solving the problem. Our collective goal was to help students become better problem solvers by using the TAPPS method. When Larry does not see that his math students are writing down their math problem-solving steps, he, in the moment, blames it on peer collaboration, instead of recognizing that he still needs to work on modeling the TAPPS method with his students.

Sandy discusses an incident that occurred when she first presented the TAPPS method to her students,

SANDY: Well, they did okay. I think it was difficult. What I saw was the people who were supposed to be talking weren't really talking, and the listener - I mean, they came around when we talked about it (whole group), but it was difficult for them to share their

thinking. I don't think their questions or their help was quite up to par. But, I mean, it's something that we work on. And your little paper that you gave (descriptions of roles for both problem solver and listener), because I haven't handed it out yet, I think will be a big help. I get this feeling that they didn't quite maybe take it seriously, but I think if we keep going they will. I wanted a little more exchange between them, and they wanted to keep it to themselves, I guess.

Sandy's demonstrates her beliefs in response to the unplanned event that occurred during her lesson. She notes that students were not purposefully sharing as she had expected. She pauses the lesson and has a whole group discussion on the expectations of the listener and the problem solver. Sandy's words suggest that she had a discussion with her students as opposed to her transmitting the information. In addition, Sandy indicates her contextualist beliefs for collaborative discussions when she expresses her disappointment that her student's discussions were not quite up to the standards she expected.

Beliefs influenced all three teachers' decisions in response to unplanned events. Carl, Larry, and Sandy shifted their goals to match their beliefs when a situation occurred that did not match their original plan.

Summary

This chapter presented the findings of the data collected during the year-long PBL PD initiative. Three fifth grade teachers, Carl, Larry, and Sandy, took part in the study. At the beginning of the study, Carl and Larry's beliefs were aligned with transmissionist epistemology and Sandy's beliefs were aligned with a constructivist epistemology. Teacher's epistemologies were determined through the use of Creswell's Adapted Interview Protocol for the pre and post PBL PDs, Schraw and Olafson's (2002) Adapted World View Vignettes and Johnston et al.'s

(2001) Adapted Teacher's Beliefs Questionnaire. All three teachers began the PBL PD in Stage 1 of their ZPDs.

As part of the PBL process, the group collaborated to find the resources that would help scaffold their learning. Through their collaboration, the teachers decided to use a book by Whimbey et al. (2013) to assist them in their learning. The book describes the TAPPS method which is based on the premise that problem-solving is best understood through discussion in a social context where the learner must self-reflect on his or her thought processes. Both Carl and Larry struggled with the listener/questioner role of the TAPPS method for learning problem solving. They continually supported each other's transmissionist views throughout the PBL PD sessions. Carl struggled to develop intersubjectivity with the premise of the TAPPS method (Whimbey et al., 2013). He believed that his low ability students were incapable of engaging in higher order thinking skills and therefore should not participate in the TAPPS method for problem solving. Carl stayed in Stage 1 of his progression through the ZPD since he did not develop intersubjectivity of the learning goal. Larry also stayed in Stage 1 of his progression through the ZPD. Larry encountered difficulties developing intersubjectivity with the TAPPS method since he had deep misconceptions of the questioner/listener role. His misconceptions were based on his poor prior experiences of the questioner role. In contrast to Carl and Larry, Sandy moved to Stage 3 of her ZPD. During the PBL PD, Sandy integrated constructivist strategies into her daily teaching practice. Sandy believed that all of her students were capable of engaging in higher order thinking skills and the TAPPS method. She eventually developed intersubjectivity with the premise of the TAPPS method and moved to Stage 3 of her progression through the ZPD.

The cross-case analysis found that three themes were consistent across the three teachers who participated in the study. These themes are Teacher's Beliefs about Student Ability, Teacher Intersubjectivity of the Learning Goal, and Unplanned Events Cause Teachers to Revert Back to Beliefs and Shift Collective Goals. The first theme, Teacher's Beliefs about Student Ability, was based on the teachers' beliefs about their math students' academic abilities. Both Carl and Larry believe that low achieving students do not have the ability to engage in higher order thinking tasks, such as the TAPPS method. Based on these beliefs, Carl, with Larry's similarly aligned epistemological views for support, discontinues using the TAPPS method with his low achieving students. Both Carl and Larry remained in Stage 1 of their ZPD. Sandy, on the other hand, believes her students are capable learners and that higher order thinking tasks are meaningful for their learning. All of her students participate in higher order thinking tasks regardless of ability. Sandy progressed to Stage 3 of her ZPD.

The second theme, Teacher Intersubjectivity of the Learning Goal, is essential to teacher learning. Scaffolding can only occur when there is a shared understanding among the participants. Carl and Larry supported each other's transmissionist beliefs and devalued the critical TAPPS questioner/listener role for learning. Both Carl and Larry remained in Stage 1 of their ZPD because they did not fully develop intersubjectivity with Whimbey et al.'s (2013) strategies for problem-solving. Sandy began the PBL PD with a limited understanding of the TAPPS method. Sandy, as compared to Carl and Larry, engaged in constructivist methods throughout her instructional day. Sandy was encouraged by both the principal and vice principal of XYZ School to use think-pair-share in the classroom. Sandy eventually started to understand the meaning of the Whimbey et al. (2013) activity and how the parts of the activity relate to one

another. Sandy gradually developed intersubjectivity with the premise of the TAPPS method (Whimbey et al., 2013). She progressed to Stage 3 of her ZPD.

The last theme, Unplanned Events Cause Teachers to Revert Back to Beliefs and Shift Collective Goals, demonstrates that teachers epistemological beliefs influenced all three teachers' decisions in response to unplanned events. Carl, Larry, and Sandy shifted their goals to match their beliefs when a situation occurred that did not match their original collaborated upon plan. Carl changed his goal of students working collaboratively on a math problem using the TAPPS method when his lesson did not go as planned. He quickly fell back on his transmissionist beliefs and created a new goal of students completing the assignment on their own with no collaboration among his students. Carl stays in Stage 1 of his ZPD. Larry also falls back on his transmissionist beliefs when he sees that his math students are not writing down their math problem-solving steps. Instead of understanding that he still needs to work on modeling the TAPPS method with his students, he instead blames their lack of writing the steps they took to solve the math problem on peer collaboration. Larry remained in Stage 1 of his ZPD. Sandy demonstrates her constructivist beliefs when an unplanned event occurs during her lesson. When Sandy encounters her students not sharing as she had modeled on a previous day with them, she stops her lesson and has a whole group discussion on the expectations of the listener and the problem solver. Sandy progresses to Stage 3 of her progression through the ZPD.

To summarize, two of the teachers started with very similar epistemological beliefs about how 5th graders can learn mathematics that were in line with transmissionist views. The third teacher had views more consistent with a constructivist view on learning. This chapter documented their experiences, findings, and provided a cross-case analysis that showed how they had similar and different experiences during the year-long PBL PD because of their initial

starting points. Chapter Five will discuss the findings and relate it to the literature reviewed that

guided the development of the study. Chapter Five will focus on supportive other, pressure,

intersubjectivity, and coherence with the school and consider the implication of the work and

make recommendations for practice.

Chapter Five: Discussion and Implications

Overview

Chapter Five discusses the findings relative to this study's constructivist theoretical framework and research questions. The purpose of this multi-case study was to investigate how problem-based learning can be used as an approach to teacher learning for elementary school teachers at XYZ School. A secondary purpose of this study was to begin to investigate how teachers' personal epistemologies may be related to how teachers make sense of a PBL PD approach to teacher learning. The chapter concludes with a discussion of the limitations of the study, areas for future research, and a brief conclusion.

Problem. Teacher PD is typically conducted in a direct instruction approach to learning where teachers passively receive information on new understandings and practices (Lieberman & Miller, 2000; Little, 1993). Teacher PD is frequently disconnected from the realities of the classroom and is routinely implemented through a top-down approach by administrators and consultants (Gibson & Brooks, 2012). Research has shown that a direct instruction or transmission style PD seldom changes teacher practice and has no effect on student achievement (Yoon et al., 2007). Many teachers also state that traditional PD programs are an ineffective approach to their professional learning (Darling-Hammond et al., 2009; Ermeling & Gallimore, 2013; Grant, 1996; Yoon et al., 2007). Although teacher PD is crucial for teachers to develop as professionals, the majority of teachers do not experience PD that is useful and beneficial to their learning (Yoon et al., 2007). To improve the professional skills of teachers, they need to continually develop their knowledge and skills to implement the best educational practices (Harwell, 2003). There is a need to find and provide teacher-learning models that utilize research

on effective PD approaches that not only empowers teachers but also permits them to expand their knowledge and understanding over time.

Purpose and questions. The decision to use a multi-case study approach for this study was based on the advantages that case studies have. Case studies are an in-depth, empirically rich, and holistic account of a phenomenon (Hodkinson & Hodkinson, 2001; Merriam, 2009; Yin, 2014). One important benefit of a case study is the ability to capture the "lived reality" (Hodkinson & Hodkinson, 2001, p. 4) of a phenomenon. Hodkinson and Hodkinson (2001) also assert that a multi-case study can help to highlight the importance of the "idiosyncratic" (p. 6). By using a multi-case study approach this researcher was able to identify features that were common across the cases and also those features that were different.

The purpose of this multi-case study was to investigate how problem-based learning can be used as an approach to teacher learning for elementary school teachers at XYZ School. A secondary purpose of this study was to begin to investigate how teachers' personal epistemologies may be related to how teachers make sense of a PBL PD approach to teacher learning.

A total of three teachers participated in this study. Each participating teacher, Carl, Larry, and Sandy, was considered a case. Data were collected by means of teacher interviews, teacher belief vignettes, a teacher beliefs questionnaire, and audio recordings of the PBL meetings and interviews This researcher's analysis of the data progressed through several stages. During the first stage, each case was treated as a single case. All the data in each case was analyzed using Creswell's (2013) generic data analysis strategy (p. 185). After each case was developed and themes identified within each case, across cases comparisons were made. The data across the cases was analyzed to identify characteristics that were common and also different. The analysis

within and across cases assisted in answering this study's research questions. During the last

stage, data was synthesized to answer this study's research questions. The research questions are

as follows:

1. What kinds of supports do teachers need during the PBL PD sessions? How does that

   scaffolding change over the course of the implementation?

2. Which components of the PBL PD model are most effective (important) for improving

   teachers' skills and/or practice?

3. How do teachers' personal epistemologies relate to how they participate in a PBL PD

   approach to teacher learning? Do teachers show any changes in their epistemologies from

   the beginning to the end of the experience?

This study contributes to the understanding of how a PBL constructivist approach to

teacher PD can be used to develop the professional skills and knowledge of teachers. It also

contributes to the understanding of how teachers use their personal epistemologies to make sense

of new knowledge and learning. The previous chapter discussed and then summarized the

findings. This chapter discusses the findings, themes, and interpretations in relation to the

research questions including implications of the findings on current practices, recommendations

for further research, and the conclusions of this study .

Research Question One: What Kinds of Supports do Teachers Need during the PBL PD

Sessions? How Does that Scaffolding Change Over the Course of the Implementation?

The crucial supports that Carl, Larry, and Sandy needed to assist their progress through

their ZPDs were assistance from a supportive other, pressure, intersubjectivity, and coherence

with the school. Movement through their ZPDs could only occur when these supports are in

place.

Supportive other. Peer collaboration is integrated throughout the PBL PD learning cycle. The PBL PD meetings are where Carl, Larry, Sandy, and this researcher worked through the tasks of our learning goal, negotiated meanings, and received assistance from one another in the form of sharing, collaboration, and emotional support. For professional growth, teachers require a collaborative environment where they rely on supportive interactions and assistance to help them move through their ZPD (Rodgers, 2002; Tharp & Gallimore, 2002). Supportive others offer alternative meanings and interpretations of experiences to help develop understanding and support inquiry. The role of supportive others is essential for critical reflection and successful learning to occur (Holton & Clarke, 2006; Puntambekar & Kolodner, 2005; Rodgers, 2002; Yuen Lie Lim, 2011).

During the PBL PD only Sandy consistently used the supportive other (the support of the facilitator, group, and book) while Carl and Larry supported each other and became resistant to the PD. With support and assistance from Carl, Larry, and this researcher, Sandy was able critically reflect and move through her ZPD. When Sandy struggled to make sense of her experiences, she listened to everyone's interpretations and then thoughtfully compared the input to her perceptions of her experiences in the classroom. Her understanding and reflections of her experiences were aided by our collaborative conversations, the Whimbey et al. (2013) book, and the constructivist assistance this researcher provided for the TAPP (Whimbey et al., 2013) tasks and literature circles. The aid Sandy received to help her critically reflect and her positive experiences helped Sandy move from one classroom experience to the next with a deeper understanding of each subsequent experience. Since her critical reflections of the experiences aligned with the constructivist approaches in the Whimbey et al. (2013) book, Sandy strengthened her attitude toward constructivist approaches and our learning goal. As Sandy

moved through her ZPD with the assistance of supportive others to help her reflect, she began to internalize what she learned. Over the course of the year, she eventually relied more on herself and less on the assistance from others to help her make meaning of her experiences. Sandy began the PBL PD at stage 1 and progressed through her ZPD to Stage 3 of her ZPD.

Carl and Larry formed an alliance and supported each other's transmissionist epistemological beliefs. When Carl or Larry tried to make sense of their experiences, they depended on one another's epistemological support to construct meaning. Dewey maintains that our interpretations are frequently based on our perceptions of the experience along with the culture of the environment and not on critical reflection. For critical reflection to occur, learners must be committed to their personal growth and open to different interpretations of the experience so that their understanding is not limited. Learners many times tend to interpret experiences quickly with little thought because they do not want to engage in the mental effort and discipline that is required to critically reflect on experiences (Rodgers, 2002; Yuen Lie Lim, 2011). Throughout the PBL PD Carl and Larry typically made quick conclusions about classroom experiences based on their transmissionist beliefs and appeared to not want to undergo the mental effort of critical reflection. Learners may shorten the act of inquiry and reflection because it is easier to accept the first answer that aligns with their beliefs as opposed to undergoing the trouble of seeking other interpretations (Rodgers, 2002). Carl and Larry were not able to move through the ZPD because their transmissionist beliefs prevented them from seeing any benefit for their students in interacting. For Carl and Larry to move through the ZPD they needed to be open to other interpretations of experiences (e.g., those provided by the supportive other) and engage in the mental effort required to critically reflect on their experiences.

Pressure. Scaffolding along with pressure is crucial to help trigger change. Understanding is developed by teachers as learners as they work through the details of the problem socially in the presence of supportive others. Guskey (1995, 2002) states that support along with subtle pressure is necessary for teacher PD. Pressure is needed to trigger change teachers who may not be very motivated to change (Guskey, 1995, 2002). It also supplies the encouragement that a teacher may need to persist in the learning that is difficult and takes a while to develop (Guskey, 1995, 2002).

In 2012, the school district began to pressure all the schools with its district to incorporate the CCSS. XYZ School started work on how to incorporate the CCSS while maintaining the traditional, back-to-basics philosophy of the school. Teachers collaborated with their grade level teams to learn the standards and begin to develop lesson plans that were aligned to the CCSS and XYZ's traditional, back-to-basics philosophy.

Although this researcher facilitated the collaborative group discussions, offered interpretations of experiences, and supported the use of the Whimbey et al. (2013) strategies for problem solving she did not have enough influence to motivate Carl and Larry to continue to use the TAPPS strategy as it was presented by Whimbey et al. (2013). They both needed more pressure to help them persist in the challenging task. Support combined with subtle pressure is crucial for new strategies and patterns to become internalized (Guskey, 1995, 2002).

Carl had the least amount of pressure placed on him by the principal and the vice principal of XYZ School because he was in a skip year of the teacher evaluation cycle, whereas both Larry and Sandy were in the year where they were evaluated in the formal teacher evaluation cycle. Sandy, was motivated by the pressure from the principals and used our conversations, the Whimbey et al. (2013) book, her critical reflections, and her observations of

the positive effects constructivist methods had on her students' learning to help her stay persistent toward achieving our learning goal.

Larry had pressure from the vice principal. He understood that the vice principal wanted to see engaged students who are interacting with one another. Larry, however, ignored the critical TAPPS (Whimbey et al., 2013) component of the active listener asking questions to push the problem solver to reflect on his or her problem-solving strategy. Instead, he had his students share with one another how they solved the math problem, eliminating the meaningful peer feedback and questioning that is essential for reflection and critical thinking. Larry was only pressured by the vice principal to have his students interact in a simple manner since the vice principal did not have a shared understanding of our learning goal, related to Whimbey's work.

Intersubjectivity. According to Tharp and Gallimore (2002), teachers must develop a common understanding or "intersubjectivity" (p. 89) of the learning goal to be achieved. Matusov and Hayes (2000), in his review of the research on intersubjectivity, states that having a shared goal is an essential requirement of the teaching-learning situation. Scaffolding or assistance can only occur when there is a shared understanding among the participants. When intersubjectivity is absent, learning conflict, lack of participation, and unpredictable outcomes may occur (Dennen & Burner, 2008; Tharp & Gallimore, 2002).

Sandy developed a shared understanding of the social interactive goal of the TAPPS approach to problem-solving. This goal was shared by the researcher, and this researcher supported Sandy's use of it in the other subject areas that she teaches. The principal and the vice principal of XYZ School also believe that learning is a social activity. They encouraged Sandy to use social interaction strategies with her students. Sandy's scaffolding changed overtime as she increasingly became self-supported. The more Sandy used the strategies in the Whimbey et al.

(2013) book with her students, the more self-supporting she became. Allen and Penuel (2014) explain that teachers need time to engage in sustained sensemaking to make meaning of the desired goals and strategies of the teacher PD. Teachers integrate what they learned into the classroom, reflect on their experiences, and then expand their pedagogical knowledge (Corcoran et al., 2003; Rodgers, 2002).

Carl and Larry acted as supportive others to one another, however, their support of one another prevented movement through their ZPD. The researcher found that Carl and Larry had developed their own shared understanding of the Whimbey et al. (2013) task based on their transmissionist epistemology. When Carl or Larry experienced cognitive dissonance during aspects of the TAPPS approach that contrasted with their long-established transmissionist teaching beliefs, they would support each others' epistemological views. They accepted limited assistance and typically only when it aligned with their beliefs. For scaffolding to occur all participants must develop a shared understanding of the goal of the activity.

Coherence with the school. Garet et al. (2001) explain that the contextual conditions of a school will most likely affect the outcomes of teacher PD. Many teachers' beliefs are situated in the social norms of the school (Jones & Carter, 2007). Teacher PD will be more effective if it is a part of a coherent program of teacher learning and development (Boyd, 1992; Clarke & Hollingsworth, 2002; Garet et al., 2001; Guskey, 2003). If teachers perceive that the PD activity does not support the critical contexts of a school, teachers will, in all likelihood, not change their practice (Clarke & Hollingsworth, 2002; Garet et al., 2001; Guskey, 2003).

Sandy began the PBL PD at Stage 1 of her ZPD. During the pre-PBL PD interview, Sandy discussed a math PD that emphasized student collaboration that was very meaningful to her, "I buy into [XYZ school's] philosophy completely. That you could still have this philosophy

and bring those elements of collaborative, problem-solving together, working, discussing, where you're just a supervisor." Many teachers' beliefs are not aligned with their practices. These teachers' beliefs may instead be situated within the social norms of the school (Feucht, 2011; Jones & Carter, 2007). Some teachers resist teaching practices that are aligned with their beliefs because of the controversy and risk that the new practice may involve (Jones & Carter, 2007).

Before the PBL PD, Sandy did not have conversations at XYZ School around teaching practices that support her constructivist beliefs since conversations among teachers at XYZ School center around transmissionist approaches to student learning. During our PBL PD meetings, Sandy began to receive support for her constructivist beliefs. Sandy and the researcher worked together and supported each other in sustained professional communication around constructivist practices. Our ongoing PBL PD conversations, and related conversations around constructivist approaches to literacy instruction (literature circles) created a new context and norms around constructivist instructional practices for fifth grade teachers at XYZ School. Because of our ongoing and sustained conversations around constructivist practices, Sandy moved to Stage 3 of her ZPD.

Guskey (1995) states that an understanding of the powerful influence that context has on PD efforts is often overlooked. XYZ School advocates a transmissionist approach to learning. XYZ teachers, for the most part, strongly believe in a traditional, back to basics philosophy. Transmissionists believe that learning is linear, progressing from simple lower order thinking to higher order more complex thinking tasks. Learning is also considered a passive activity (Zohar et al., 2001). Carl was a key member of the XYZ School philosophy committee. He often belittles social constructivist styles of teaching. Larry does not see activities as meaning-making

processes. Both of their beliefs were aligned with the transmissionist philosophy of XYZ School. Carl and Larry started the PBL PD in Stage 1 of the ZPD.

XYZ School groups fourth and fifth grade students according to ability. Carl teaches the low ability math group. The first time Carl encountered difficulty modeling the TAPPS approach to problem solving with his low ability students, he quickly gave up. He claimed that his students are unable to engage in the TAPPS method and higher order thinking approaches. Larry supported Carl's beliefs that students must engage in basic skills instruction before they can move on to higher order thinking approaches. Carl, with Larry's support, gave up using the TAPPS method with his low ability students. Teacher to teacher relationships also form the context of the school (Boyd, 1992; Clarke & Hollingsworth, 2002). The contextual characteristics of XYZ School where students must engage in basic skills instruction before they can move on to higher order thinking approaches and Carl's contextual relationship with Larry became a barrier for Carl's movement through his ZPD. Carl stayed in Stage 1 of his ZPD.

Guskey (1995, 2003) states that the uniqueness of a specific school's contextual characteristics will always be a critical factor when designing teacher PD. Larry developed deep misconceptions of the questioning role during a math PD training held at another elementary school. The PD trainers demonstrated how to model the questioning process with teachers from a variety of schools. Because of the transmissionist contextual characteristics of XYZ School, it was not expected that XYZ teachers implement the questioning strategy into their instructional practices. The only conversation among the fifth grade teachers about the training were how the trainers allowed the teacher to believe that he solved the problem correctly even when he was incorrect. Guskey (2003) explains that if a teacher does not believe that a PD activity supports the foundational contexts of the school, the teacher will more than likely not try to incorporate

the strategies he or she learned into instructional practice. Larry does not value the role of the TAPPS questioner/listener as a meaning making process and method for self-reflection. The TAPPS method for problem solving was not coherent with the transmissionist contexts of XYZ School. Larry remained in Stage 1 of his ZPD.

Research Question Two: Which Components of the PBL PD Model are Most Effective (Important) for Improving Teachers' Skills and/or Practice?

As a group, we worked collaboratively through the first five phases of the PBL learning cycle. These phases required us to identify a problem, discuss the current situation of the identified problem, brainstorm possible solutions, formulate learning goals, and find information to help solve our problem. We choose to use the book, *Problem Solving & Comprehension* (Whimbey et al., 2013), to help us answer our driving question, "how can we help our students become better problem solvers?" This book promotes constructivist methods such as collaborative problem solving, questioning, and reflecting on thought processes. We also used other books by Arthur Whimbey to help develop our students' problem-solving skills. Carl and Larry had epistemological views aligned to transmissionist view of learning and Sandy's were aligned to a constructivist view; it was when we entered into the last two phases of the PBL learning cycle, "Applying Knowledge" and "Mediate and Reflect" Carl, Larry, and Sandy's epistemological beliefs either assisted or created a barrier to their learning.

Applying knowledge. Applying knowledge is the phase of the PBL Learning Cycle (see Figure 1) where the knowledge learned from discussions and the SDL phase is applied in the classroom. True learning occurs when learners have been through learning experiences and then ''weave meaning among the threads of experience'' (Rodgers, 2002, p. 847).

Sandy adopted a favorable attitude toward constructivist approaches as a result of the continuity and reflections of her experiences. She observed the positive effects student dialogue had on her students' learning and noted that her students enjoy collaborative math tasks. She found that her students were highly engaged when they worked together to solve problems. As a result of the continuity of her experiences, she began to regularly use constructivist strategies with her students throughout her instructional day. Toward the end of the PBL PD, Sandy proclaims to Larry, Carl, and the researcher that the use of constructivist strategies are powerful for student learning.

Larry firmly believes that the active listener role was not a valuable component of problem solving. He experienced success the first time he implemented the TAPPS method, however, he later decides that his high achieving math students did not want to show their work on paper because they prefer to talk over showing their work. Larry also experienced how difficult it is for him to ask questions so he concludes that asking questions is too difficult for his students. He reverts back to how he had his math students problem-solve before the PBL PD. Whimbey et al. (2013) state that the active listener role is critical for student problem-solving because it helps promote students' metacognition. Larry forgoes the questioning process of the active listener and instead has his students simply share how they individually solved the math problem with one another. Rodgers (2002) explains that without a continuity of experiences learning becomes random and disconnected. True learning can only occur when learners have reflected with others on a continuity or thread of experiences (Rodgers, 2002).

Carl experienced frustration when he tried to implement the TAPPS method with his math students. During our PBL PD collaborative meetings, Carl shared his experiences with the group. When the experiences did not go as planned, he ascribed the experiences to his low

achieving math students' inability to engage in the TAPPS method and higher order thinking approaches. According to transmissionist beliefs, learning is linear, progressing from simple lower order thinking to higher order more complex thinking tasks (Zohar et al., 2001). Carl believed his students must learn the basics before engaging in higher order thinking tasks. Many teachers use basic skills instruction with their lower achieving students as a classroom management strategy to keep them busy with slow and routine tasks, while also satisfying their assumed predilection for easy work (Zohar et al., 2001). Lower achieving students frequently experience a lower order, transmission of knowledge approach to instruction because many teachers believe their lower achieving students are unable to move past the beginning simpler stages of the learning process.

Since Carl believes that learning progresses from simple to complex, he concluded, with Larry's transmissionist support, that his lower-achieving students are not able to engage in the TAPPS higher order thinking tasks until they have mastered lower order thinking tasks. Without a continuity of experiences Carl's learning was halted and he was unable to broaden his field of experience and knowledge.

Mediate and reflect. Mediate and Reflect is the phase of the PBL Learning Cycle (see Figure 1) where Carl, Larry, Sandy, and this researcher regularly met to discuss and reflect on our experiences and learning form the Whimbey et al. (2013) book. True learning develops only after a learner has critically reflected on his or her learning experiences. The process of reflection must take place in a community and in interaction with others. Reflection requires seeing the experience imaginatively as others may interpret it. Considering others interpretations of the experience allows for deeper understanding and meaning making (Rodgers, 2002; Yuen Lie Lim, 2011). Rodgers (2002) states that it is through the continuity of a teacher's learning experiences

and the critical reflections of these experiences with others that the teacher as learner transforms his or her assumptions to inform the teacher's future actions and practices.

Conversations among teachers at XYZ School center around transmissionist approaches to student learning. Due to the culture and direct instruction philosophy at XYZ School, Sandy had limited opportunities before the PBL PD to engage in conversations around constructivist teaching methods to make meaning of her experiences. At the beginning of our peer collaborations, Sandy thought that the TAPPS listener/questioning component was akin to "criticism." However, as the PBL PD progressed over time, Sandy thoughtfully analyzed and assessed the reasonableness of Larry's, Carl's, and this researcher's statements as we tried to make sense of her classroom experiences together. As Sandy critically reflected on her experiences and witnessed first hand the positive effects constructivist teaching methods had on her students, she began to apply them throughout her instructional day. Sandy's continuity of experiences combined with our collaborative reflective analysis of her students' behaviors helped Sandy make sense of and solidify her beliefs. Sandy progressed through her ZPD to Stage 3 where assistance is minimally needed and regulation has been internalized and automatized (Tharp & Gallimore, 2002).

Larry shared with the group a significant incident for him where the district's expert math PD trainers had trouble modeling questioning with teachers. Carl was also at this training, and the two of them had a shared understanding of the incident. They both developed a misconception that the questioner permits students to develop a false understanding of how to solve math problems. This event shaped Larry's views on the questioning role, and he developed assumptions and deep misconceptions on the questioning process. Even when confronted by his good friend Carl toward the end of our PBL PD on his misconceptions, Larry still struggled to

reflect. Larry explains that questioning was hard for the PD trainers and that he himself also finds it difficult to be in the questioner role. In his view, if he and the PD trainers have difficulty, then his fifth-grade students will undoubtedly struggle. Since Larry's prior experiences and views on the questioning role were negative, he discontinued the use of the role of the active listener. Smith, Disessa, and Roschelle (1994) state that deep misconceptions are difficult to overcome, and that conceptual change is complex and takes time. Yuen Lie Lim (2011) explains that the lowest level of reflection is "Habitual Action" (p. 173) where the learner falls back on his or her prior knowledge with no appraisal or evaluation of ideas. Critical reflection not only has to occur in interaction with others, but also requires that the learner make meaning by moving from one experience to the next with a deeper understanding of each subsequent experience. It is this thread of continuity that makes learning possible (Rodgers, 2002). For Larry to move through his ZPD, he would need to see someone modeling questioning well, and then have opportunities to practice the questioning role to build on a continuity of experiences. He had difficulty reflecting because he had not seen the questioning method he was trying with his students modeled successfully. Larry was not able to move past Stage 1 of his ZPD (Tharp & Gallimore, 2002).

Larry analyzed Carl's experiences with a transmissionist view of the situation when Carl shared his struggles with constructivist teaching approaches. Larry's transmissionist explanations and validations made sense to Carl, and therefore Carl did not feel compelled to engage in critical reflection. Using the assumption that his low ability math students could not move on to higher order thinking tasks until they have achieved the simpler basic steps, Carl stopped trying to use the TAPPS method in his classroom. Rodgers (2002) states that learners must have a continuity of experiences for reflection to occur. Yuen Lie Lim (2011) asserts that critical

reflection can only occur when learners consider a variety of interpretations and question their assumptions. Since Carl did not have a continuity of experiences to reflect on critically and did not consider other possibilities as a solution, he did not move past Stage 1 of his ZPD (Tharp & Gallimore, 2002).

Research Question Three: How Do Teachers' Personal Epistemologies Relate to How They Participate in a PBL PD Approach to Teacher Learning? Do Teachers Show Any Changes in their Epistemologies from the Beginning to the End of the Experience?

Fosnot and Perry (1996) state that constructivism is in direct opposition to behaviorism. Constructivism focuses on deep understanding as opposed to basic knowledge and skills as the goal of instruction. The researchers explain that constructivism does not view learning as a linear process but rather as complex and nonlinear in nature. PBL is an approach to learning that is true to the central tenets of constructivism (Savery & Duffy, 1995). It is a cyclical process that continues until one or more solutions develop to create an appropriate conclusion to the problem or learning issue (Hmelo-Silver, 2004).

Sandy began the PBL PD with a personal epistemology that aligns with a contextualist worldview. Before the PBL PD started, Sandy, as a result of the transmissionist philosophy of XYZ School, had limited opportunities to foster her constructivist beliefs and practices. She states during the pre-PBL PD interview that she believes in XYZ School's transmissionist philosophy but that she also supports peer interactions and teacher scaffolding through questioning. Since the group decided to use social interactive learning approaches to problem-solving to answer our driving question, Sandy was given an opportunity to develop and use her constructivist beliefs to make meaning of her experiences. When Sandy struggled to adapt what she learned from her experiences in the classroom, she did not fall back into her former

predictable teaching practices. Instead Sandy embraced the struggle she encountered to make meaning of her experiences. Our collaborative conversations forced Sandy to look at her experiences from different angles. She was compelled to examine more deeply her beliefs and assumptions. Sandy used our collaborative conversations, her critical reflections, and her classroom experiences to expand her previous understandings to develop a deeper understanding of her beliefs on how her students learn. Sandy not only was able to work recursively through the PBL PD learning cycle but because of her efforts, she also was able to progress through her ZPD to reach Stage 3.

Both Larry and Carl began the PBL PD with a realist worldview which is associated with transmissionist beliefs about knowledge. Realists believe that learning is linear, progressing quantitatively from simple to complex (Fosnot & Perry, 1996; Zohar et al., 2001). Larry and Carl value instructional efficiency and consider social interactive learning an inefficient method for student learning.

Carl struggled with modeling the TAPPS method to his math students. When a student questioned him, he quickly gave up and assigned the math problems as homework. Teachers may experience extreme difficulty, stress, resentment, and/or anxiety during the early stages of a training when an unfamiliar teaching model is being implemented (Tharp & Gallimore, 2002). Instead of persisting with the TAPPS method, Carl, with the strong support of Larry's realist beliefs, decided that the TAPPS method was too challenging for his low achieving math students. Dewey (Dewey, 1933; Rodgers, 2002; Tharp & Gallimore, 2002) explains that during and after an experience is when a teacher makes an interpretation of the experience. He states that teachers may react by jumping to conclusions or shortening the inquiry process due to a disinclination of effort. These reactions to situations are automatic with little thought attached. Dewey asserts that

learners have a tendency to see what they want to see. It is when a teacher is open to reasoning through the complexity of the problem and considering how others may see it is when meaning of the experience can develop (Dewey, 1933; Rodgers, 2002; Tharp & Gallimore, 2002). Carl did have his students work together to solve problems, but he found the conversations nonproductive, especially in light that some of his students had answered the math problems incorrectly. Constructivist learning environments require that learners struggle with problems in order to solve them. The learner's struggles place higher metacognitive demands, (i.e., in reflecting, thinking through all the issues and differences, planning, monitoring, and evaluating) on the learner (Applefield, Huber, & Moallem, 2000). Carl chose to fall back on the familiarity and safe boundaries of his epistemological beliefs over the metacognitive demands that he was experiencing during the PBL PD while trying to bring in TAPPS methods to his classroom. Carl did not work recursively through the PBL PD learning cycle. He stayed in Stage 1 of his ZPD.

Larry, although open at first to the TAPPS active listener role, also relied on his realist beliefs and attitudes when he failed to see the active listener role as a means for developing higher order thinking for his students. Zohar et al. (2001) state that teachers' beliefs have strong implications for the way they teach.

Larry's prior negative experiences and misconceptions of the questioner role was also a barrier for him to explore alternative ways of thinking and reflecting about learning. Dewey describes a mis-educative experience as one that "arrests or distorts growth" (Rodgers, 2002, p. 847). A mis-educative experience leads to routine actions, self-serving motives, and stagnation as opposed to forward movement and critical reflection (Rodgers, 2002). Larry preferred to rely on his existing theories of learning and only added a strategy to his instructional strategy toolbag that did not conflict with his beliefs on how students problem solve. His students solved math

problems independently without peer support for critical reflection. Only after students had solved the math problem independently did they share their solution with another student. Jones and Carter (2007), in their study of teacher beliefs and how beliefs influence instructional practices, found that teachers with transmissionist beliefs tried new instructional strategies in their classrooms, although the new strategies that they chose to use were those strategies that conflicted the least with their transmissionist belief systems. Larry, like Carl, did not move past Stage 1 of his ZPD as compared to Sandy who progressed to stage 3 of her ZPD.

Conclusions

The focus of this multi-case study was to explore how problem-based learning can be used as an approach to teacher learning for K-5 teachers at XYZ School. A secondary focus was to look at how teachers' personal epistemologies may be associated with how teachers make sense of a PBL PD approach to teacher learning. The findings of this study lead to three conclusions. Implications based on the findings and recommendations for future research were presented.

Conclusion 1. A PBL constructivist approach to teacher PD can be used as a meaningful approach to teacher PD. The design and methodology used for this study were especially useful for identifying and understanding the PBL constructivist supports and components that are essential for developing the professional skills and knowledge of teachers. The case studies that were developed provided rich and detailed data for making sense of a PBL approach to teacher development.

Conclusion 2. The supports that teachers need to assist their progression through their ZPD are assistance from a supportive other, pressure from respected leaders, intersubjectivity of the learning goal, and coherence with the school. Teachers need a continuity of experiences and

critical reflection of their experiences (Rodgers, 2002). The process of reflection must take place with a community of learners who are part of a coherent program of teacher learning and development (Boyd, 1992; Clarke & Hollingsworth, 2002; Garet et al., 2001; Guskey, 2003). Without these crucial supports, learning conflict and a lack of progression through the ZPD will occur (Dennen & Burner, 2008; Tharp & Gallimore, 2002). True learning can only occur after a learner has critically reflected on his or her learning experiences (Rodgers, 2002). Teachers cannot develop a deep understanding of their experiences when these components are lacking.

Conclusion 3. Teacher epistemology plays a factor in how teachers participate in a PBL environment. If the approach to learning a new task does not match the learner's epistemological beliefs on how people learn, rather than struggle, some learners may retreat to the familiarity of their epistemological beliefs. Teachers may also prefer to rely on their existing theories of learning. Under those circumstances, the teacher may only focus on a small portion of the learning task to be acquired, that which least conflicts with their epistemological beliefs (Tharp & Gallimore, 2002). Furthermore, if teachers believe that the PD activity is not aligned with the critical contexts of the school, they will most likely not change their existing theories of learning (Clarke & Hollingsworth, 2002; Garet et al., 2001; Guskey, 2003).

Implications for Practice

The results of this study can inform school leaders regarding the supports they can use to engage teachers in meaningful and relevant teacher PD. The results can also assist in understanding how a teacher's personal epistemology may influence how teachers participate in constructivist learning environments (Brownlee et al., 2011; Howard et al., 2000; Luft & Roehrig, 2007; Maor, 1999; Prytula et al., 2010; Smith, 2013; Yang et al., 2008; Zohar et al., 2001). The recommendations in this section are proposed as suggestions to school leaders who

are designing PBL experiences as an approach to teacher PD and want to use a constructivist approach to develop the professional skills and knowledge of teachers.

School leaders will need to establish the crucial supports that teachers need during the PBL sessions to help them move through their ZPDs. One such support is the vital role of the supportive other (Tharp & Gallimore, 2002). As teachers work collaboratively through the details of the learning experience, supportive others can offer different interpretations so that understanding is not limited and critical reflection can occur (Holton & Clarke, 2006; Puntambekar & Kolodner, 2005; Rodgers, 2002; Yuen Lie Lim, 2011). When setting up teacher groups for PBL PD, school leaders should carefully consider the makeup of the group. Creating groups with teachers who have strong similar beliefs may shorten the act of inquiry since learners may accept the first answer that aligns with their beliefs than undergoing the difficult task of seeking other interpretations (Rodgers, 2002). Recruiting teachers with a variety of beliefs is essential for critical reflection to occur (Yeo, 2005; Yuen Lie Lim, 2011). School leaders will need to emphasize to teachers as learners the importance of being open to the supportive others' alternative meanings and interpretations of their experiences.

Another crucial support for teachers who are not motivated to persist in the mental effort and discipline that is necessary for critical reflection to occur during the PBL PD is subtle pressure from respected leaders (Fullan, 2001; Guskey, 1995, 2002; Rodgers, 2002). Although teacher leaders can act as facilitators by modeling and coaching strategies for learning and thinking, they may not have enough influence to motivate teachers to continue with a task that is deemed challenging. Teachers who are not motivated to continue because a task may be too challenging or mentally taxing require pressure from a respected leader who understands the goals of the task (Guskey, 1995, 2002). Teacher leaders can assist respected leaders

understanding of the task by sharing with respected leaders the question and the goals that the teachers developed together during their PBL sessions (Garet et al., 2001). Respected leaders can then provide subtle pressure on teachers as learners in the form of feedback and positive reinforcement that are aligned with the shared understanding of the goals of the task (Fullan, 2001; Guskey, 1995, 2002; Howard et al., 2000). Respected leaders should also meet periodically one on one with each teacher to check in on progress and find out if there are challenges they may need help with to achieve their learning goals. Guskey (1995) states that it is important that PD efforts involve people from all levels of the organization. Although PBL PD is an approach that gives ownership to teachers for their learning, subtle pressure by respected leaders is also a necessary scaffold for teachers to continue to persist in their learning goals (Fullan, 2001; Guskey, 1995, 2002; Rodgers, 2002).

A third highly critical support that school leaders need to ensure for learning to occur is intersubjectivity of all teacher participants (Dennen & Burner, 2008; Tharp & Gallimore, 2002). Teachers who are struggling with developing intersubjectivity of the learning goal should be given opportunities to observe and/or co-teach lessons with teachers who are comfortable exploring the strategies in the classroom that align with the learning goal. Opportunities to observe and/or co-teach lessons with teachers who are comfortable exploring learning goal strategies is especially important for teachers who hold contrasting epistemologies than what is required for the learning goal to be achieved. These paired opportunities could provide a safety net for teachers who have contrasting epistemologies. For example, if a lesson does not go as planned, then struggling teachers will have the assistance of another teacher to help with the lesson or critically reflect on what the struggling teacher "perceived" went wrong. Struggling teachers may eventually feel more comfortable trying the new strategies on their own if they

have a teacher, ideally, with differing beliefs, they can have meaningful dialogue with about lessons that were observed and/or co-taught. Teachers should continue to observe and/or co-teach and then reflect on the lesson with one another until struggling teachers feel comfortable applying the new strategies on their own in their classrooms. Observations and co-teaching will not only provide a system of support but also a continuity of experiences for teachers. True learning can only occur when teachers as learners have critically reflected with others on a continuity of experiences (Rodgers, 2002).

To improve the results of teacher PD, school leaders need to take into account the contextual elements of a school (Boyd, 1992; Clarke & Hollingsworth, 2002; Guskey, 2003). Some components to take into account when planning teacher PD are the beliefs and attitudes of the people within the school, the cultural norms, relationships, and ecology of the school. Failure to recognize the influence of the contextual elements of a school can affect the results of the teacher PD (Boyd, 1992; Clarke & Hollingsworth, 2002; Garet et al., 2001; Guskey, 2003). For example, the culture of a school can influence teachers willingness to change or participate in the teacher PD. Implementing effective teacher PD requires an understanding from school leaders of how the contextual elements of a school may influence teachers' attitudes toward the teacher PD (Clarke & Hollingsworth, 2002; Guskey, 2003; Lieberman & Miller, 2000).

Internal Study Validity & Limitations

This study involved multiple strategies to ensure that it is trustworthy. To ensure trustworthiness, the same procedures and protocols were used for the pre and post interviews and the PBL PD meetings. The same vignette summary (Appendix A) for each participant was also used during the pre and post PBL PD interviews. Member checking was conducted during the pre and post PBL PD interviews by questioning each participant to determine the accuracy of

their statements. All interviews and PBL PD meetings were audio recorded and analyzed by the researcher to ensure the trustworthiness of the data analysis. The researcher developed a rich and thick description of the data so that it can be reviewed by others. Additionally, continuous reflexive bracketing by the researcher helped ensure the trustworthiness of the data analysis. To develop the rich context of this study the researcher facilitated validation through triangulation. This researcher triangulated the data from the teacher interviews, observations, teacher belief vignettes, and the teacher beliefs questionnaire to ensure accuracy of finding interpretation. In addition, each of the three cases were triangulated using a cross-case analysis process.

A qualitative study's limitations are the potential weaknesses related to the sample, design, analysis, or methodology that influenced the interpretation of the findings from the research (Price & Murnan, 2004). One potential limitation of this study was related to the sample; the school involved had a Back to Basics philosophy where direct instruction is emphasized as a preferred teaching method. The school's strong emphasis on direct instruction is dissimilar from other elementary schools. Only around one percent of elementary schools in the United States use direct instruction as a preferred method of instruction (Pullmann, 2017). The direct instruction philosophy of the school may limit replicability of the findings. Another potential weakness of the findings was that Sandy received more interaction with the researcher than Carl and Larry did. Outside of the PBL PD, the researcher and Sandy collaborated on other projects, for example, this researcher scaffolded Sandy's use of literature circles. Literature circles use a social constructivist learning approach. Sandy and I had ongoing conversations on how to manage social interactive learning experiences which may have helped her develop intersubjectivity with a more constructivist approach to learning. One other limitation was the number of participants in the study. The small sample size may limit transferability (Lincoln &

Guba, 1985). To assist the reader in making decisions about transferability, this researcher provided rich and thick descriptions of the participants and the findings. However, even with these provisions, transferability may be limited. This researcher's biases are also a possible limitation of this study. The researcher's beliefs and familiarity with participants and the situation may have influenced the data interpretation and possibly the results of this study. To address this concern, this researcher practiced reflexive bracketing and had a peer-reviewer as part of the coding process to minimize areas of potential bias and their influence on my research process.

Suggestions for Future Research

There are very few studies currently available on the use of PBL as a PD model for teacher learning. The educational field would benefit from further research on how PBL can be used as a meaningful and relevant learning opportunity for teachers. Also, there are many gaps in the research on how PBL used as a constructivist approach to teacher learning may affect teachers' epistemological beliefs. Further research could expand the findings of this study. Additional data from other research studies would be pivotal in answering this study's research questions. Future studies could investigate PBL as an approach to teacher learning in school contexts other than those with a focus on direct instruction. Future researchers could also use a larger sample size than what was used in this study. Another area that could be investigated is enlisting teacher participants who teach not only the same grade level but who also teach classes that are similarly composed either by similar or mixed ability levels. Teachers who teach similarly composed classes could provide more support to one another which may lead to a continuity of experiences for participants and critical reflection. Further research on the use of external pressure to aid teachers in initiating change could be explored also. Additionally, it

would be useful for researchers to consider issues of fostering critical reflection among teachers with differing epistemologies. Last, this study did not address how PBL as an approach to learning impacts student's achievement. Future research should consider how a PBL approach to teacher PD could influence student learning.

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APPENDIX A

Schraw and Olafson's (2002) Adapted World View Vignettes

Vignette 1

There is a core body of knowledge in my classroom that each student must learn. Some of it is factual, but some of it is based on broad concepts and principles that everyone agrees on. This knowledge doesn't change much over time and represents the accumulation of important truths and understanding in my discipline. It's important for students to acquire this knowledge exactly as it is. The best way to acquire this knowledge is through an expert like me because I have a much better sense than they do of what is important to learn. It's unlikely that students could really create this knowledge on their own, so learning it from me quicker and more efficient. For this reason, it is important to me to assume a take-charge attitude so students can learn as much as possible. It's important to me that everyone comes away from my class with the big picture. It is my job to present the big picture clearly.

Strongly Agree   Agree   Neutral   Disagree   Strongly Disagree

Vignette 2

Students are encouraged to develop their own understanding in my classroom so knowledge is personally useful to them. However, the fact that students are expected to construct their own understanding doesn't mean that all understandings are equally valid. While I believe that knowledge is subject to interpretation, I also believe that some conclusions are better than others. Students need to understand how to gather and evaluate evidence so they can distinguish good from poor arguments. I can teach them some of these skills, but some they will have to learn by working with other students, or on their own. I believe that each student will bring a unique and valuable perspective with them. I try to structure my class so that students will pool their resources and come to the best understanding possible.

Strongly Agree   Agree   Neutral   Disagree   Strongly Disagree

Vignette 3

Students in my class need to understand that there are a variety of different ways to understand things. Knowledge comes and goes, and what the so-called experts consider the truth today will be viewed with suspicion tomorrow. Even people who spend years studying a topic disagree about what things mean, and in the long run, one opinion is as good as another. This means that students have to learn to think for themselves, question the knowledge and authority of others, and evaluate how what they know affects their life. Knowledge has to be used wisely so no one is left out or exploited by society. For these reasons, I don't believe that I can really teach my students what is important, since they all need to know different things. They have to figure it out on their own, taking into account the events that shape their lives, even if the uncertainty of living in a world with conflicting views of truth bothers them. What I know and believe

shouldn't really influence my students. My job is to create an environment where students can learn to think independently and take nothing for granted.

Strongly Agree   Agree   Neutral   Disagree   Strongly Disagree

Participant's Name_____Date_____

APPENDIX B

PBL Meeting Protocol

Date:

Place:

Facilitator:

Teachers Present:

Location of the Meeting:

Phase(s) Worked On:

1. Facilitator begins with an open huddle to review the past PBL meeting, review the task list, and asks for input and questions.

    Recursion through PBL Learning Cycle:

2. Identify facts: teachers report on their research findings.

3. Mediate and reflect: group analyzes and evaluates research findings and its usefulness in applying it to the problem.

4. Set new goals and make a plan: teachers adjust task lists and add any new needed information, resources, and research questions.

5. Readjust previous hypothesis if necessary.

APPENDIX C

First PBL Meeting Protocol

Date:

Place:

Facilitator:

Teachers Present:

Location of the Meeting:

Phase One: Identify the problem that will be worked on by the group. The group discusses the current situation of the problem and what they know from their experiences of the problem. During this phase, the group will define working definitions and brainstorm what features of the problem should be the focus.

Phase Two: teachers will discuss what questions need to be answered to clarify the problem. Teachers brainstorm possible solutions and explanations.

Phase Three: the group will develop a working hypothesis that will be the starting point for the PBL PD.

Phase Four: teachers will formulate their learning goals, create an outline of what information is still needed to answer questions, and how to obtain the new information.

Phase Five: teachers work on their learning goals and research new information during the SDL phase.

APPENDIX D

Informed Consent for Participation in Research Activities

PEPPERDINE UNIVERSITY

**A MULTI-CASE STUDY OF A PROBLEM-BASED LEARNING
APPROACH TO TEACHER PROFESSIONAL DEVELOPMENT**

You are invited to participate in a research study conducted by Michaela Jacobsen, who is a Doctoral Student Candidate at Pepperdine University, and her faculty advisor, Dr. Judi Fusco Kledzik, because you are a teacher that teaches at ▮▮▮ Elementary School. Your participation is voluntary. You should read the information below, and ask questions about anything that you do not understand, before deciding whether to participate. Please take as much time as you need to read the consent form. You may also decide to discuss participation with your family or friends. If you decide to participate, you will be asked to sign this form. You will also be given a copy of this form for you records.

PURPOSE OF THE STUDY

The purpose of the study is to explore how problem-based learning can be used as an approach to teacher professional development for K-5 teachers at ▮▮▮ Elementary School. A secondary purpose of this study is to start to investigate how teachers' personal beliefs about knowledge and learning may be related to how they make sense of a problem-based learning approach to teacher professional development.

STUDY PROCEDURES

If you volunteer to participate in this study, you will be asked to:

- Take an eight-item questionnaire developed by the researcher to assess your personal beliefs about knowledge and learning.

- Participate in two 45 minute interviews with the researcher, Michaela Jacobsen.

- Participate in a problem-based learning approach to professional development that will consist of three to five teachers and the facilitator/investigator.

- Participate in 15 hours of professional development from September 2015 to March 2016.

- Use your personal time over the school duty day to independently conduct research to prepare for PBL PD meetings.

- You will be video-recorded if you decide to participate in this study. The video recordings will be used for the purposes of this study only and will be destroyed upon completion of the study. You cannot participate in this research study if you do not wish to be video-recorded.

POTENTIAL RISKS AND DISCOMFORTS

There are no anticipated risks involved in participating in this study outside the inconvenience in terms of time spent doing research past your duty day.

POTENTIAL BENEFITS TO PARTICIPANTS AND/OR TO SOCIETY

This study is beneficial because it is an attempt to create a new approach to professional development that may be useful and beneficial for teachers.

CONFIDENTIALITY

I will keep your records for this study as far as permitted by law. However, if I am required to do so by law, I may be required to disclose information collected about you. Examples of the types of issues that would require me to break confidentiality are if you tell me about instances of child abuse and elder abuse. Pepperdine's University's Human Subjects Protection Program (HSPP) may also access the data collected. The HSPP occasionally reviews and monitors research studies to protect the rights and welfare of research subjects.

The data will be stored on a password-protected computer in the investigator's place of residence. The data will be stored for a minimum of three years. You will be assigned a pseudonym prior to the investigator collecting data. So as to protect your responses and data, a pseudonym will be used throughout in the final write up of the study. On all data collection instruments and transcripts, identifying information will be stricken out and replaced with pseudonyms. All video recordings of the interviews and video recordings of the professional development meetings will be stored in a password-protected file on the investigators' computer at her residence. Video recordings of the interviews and PBL meetings will be transferred to the investigator's personal computer at her residence the same day the recordings take place. The recordings on the video camera will be immediately deleted once video recordings have been transferred to the investigator's personal computer. All video recordings stored on the investigator's personal computer will be destroyed at the end of the investigator's defense. All the data collected from the interviews, vignettes, field video, and the questionnaire will be stored in a password-protected file on the investigator's computer at her residence for three years and then destroyed.

PARTICIPATION AND WITHDRAWAL

Your participation is voluntary. Your refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may withdraw your consent at any time

and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study.

ALTERNATIVES TO FULL PARTICIPATION

Your alternative is to not participate.

INVESTIGATOR'S CONTACT INFORMATION

I understand that the investigator is willing to answer any inquiries I may have concerning the research herein described. I understand that I may contact Dr. Judi Fusco Kledzik, the investigators' Doctoral Study Advisor, at Judith.Kledzik@pepperdine.edu if I have any other questions or concerns about this research. If you have questions about your rights as a research participant, contact Dr. Thema Bryant-Davis, Chairperson of the Graduate & Professional School Institutional Review Board (GPS IRB) at Pepperdine University, via email at gpsirb@pepperdine.edu or at 310-568-5753.

RIGHTS OF RESEARCH PARTICIPANT – IRB CONTACT INFORMATION

If you have questions, concerns or complaints about your rights as a research participant or research in general please contact Dr. Thema Bryant-Davis, Chairperson of the Graduate & Professional School Institutional Review Board at Pepperdine University 6100 Center Drive Suite 500 Los Angeles, CA 90045, 310-568-5753 or gpsirb@pepperdine.edu.

SIGNATURE OF RESEARCH PARTICIPANT

I have read the information provided above. I have been given a chance to ask questions. My questions have been answered to my satisfaction and I agree to participate in this study. I have been given a copy of this form.

Name of Participant

Signature   Date

SIGNATURE OF INVESTIGATOR

I have explained the research to the participants and answered all of his/her questions. In my judgment the participants are knowingly, willingly and intelligently agreeing to participate in this study. They have the legal capacity to give informed consent to participate in this research study and all of the various components. They also have been

informed participation is voluntarily and that they may discontinue their participation in the study at any time, for any reason.

_____
Name of Person Obtaining Consent

_____   _____
Signature   Date

APPENDIX E

The PBL Learning Cycle
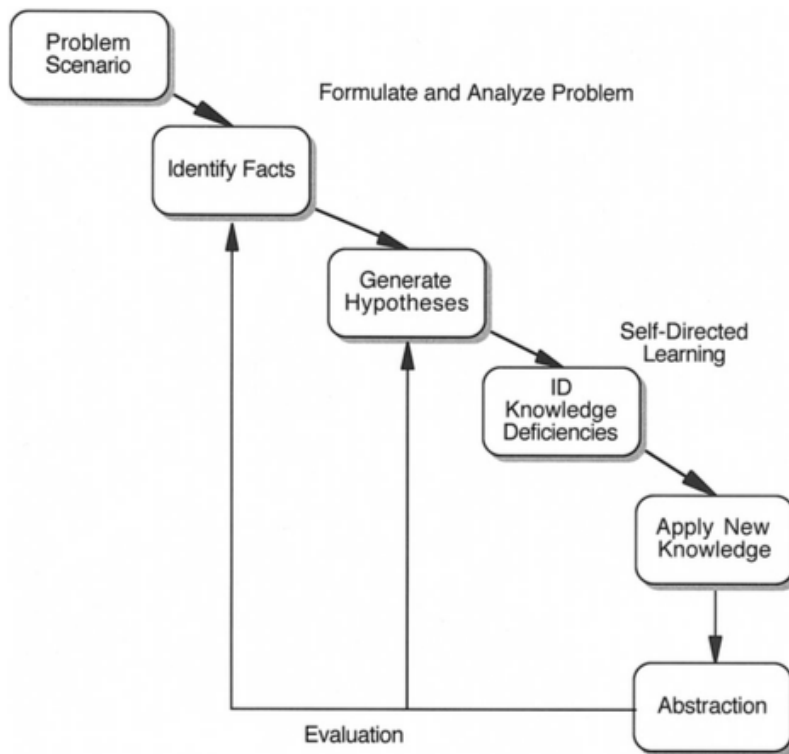

Figure 1. The PBL learning cycle. Reprinted from "Problem-Based Learning: What and How Do Students Learn?," by C. Hmelo-Silver, 2004, *Educational Psychology Review, 16*(3) p. 237. Reprinted with permission.

APPENDIX F

PBL PD Learning Cycle adapted from Hmelo-Silver's "PBL Learning Cycle"
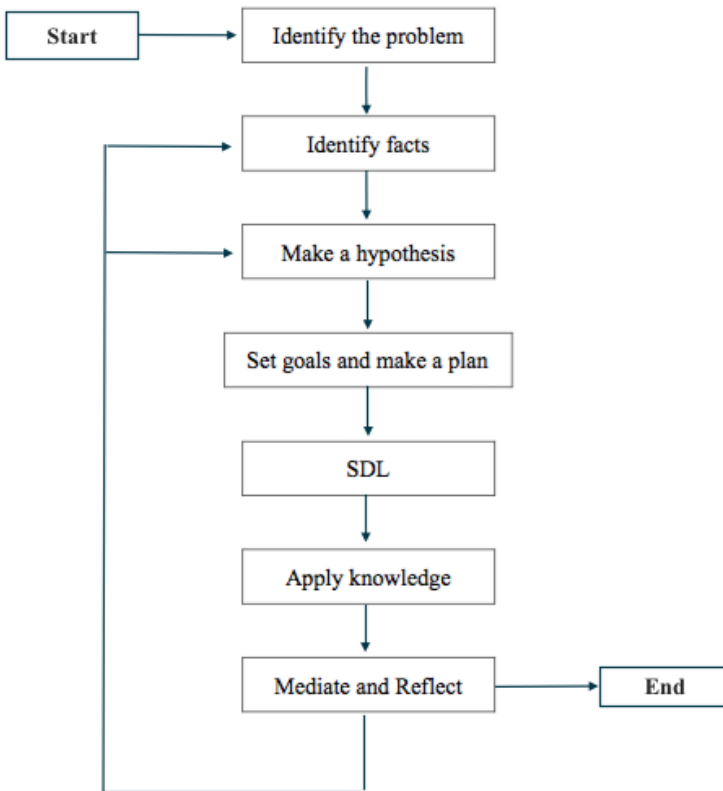

Figure 2. PBL PD learning cycle adapted from Hmelo-Silver's "PBL Learning Cycle" (2004).

APPENDIX G

Creswell's Adapted Interview Protocol for pre PBL PD

Time of Interview:

Date:

Place:

Interviewer:

Interviewee:

Position of Interviewee:

Interview Questions:

1.   What has been your past experiences with teacher professional development?

2.   What did you find most effective?

3.   What did you find least effective?

4.   How have you used what you learned from past professional development experiences?

5.   Tell me what you know about and how you would define Problem-Based Learning?

6.   Please read the following vignettes and circle how much the vignettes describe your own

beliefs. Circle if you strongly agree, agree, feel neutral, disagree or strongly disagree that the

vignette describes your beliefs.

7.   Please tell me more about your beliefs for each vignette.

APPENDIX H

Creswell's Adapted Interview Protocol for Post PBL PD

Time of Interview:

Date:

Place:

Interviewer:

Interviewee:

Position of Interviewee:

Questions:

1. What elements of the PBL PD did you find effective?

2. What elements of the PBL PD did you find ineffective?

3. How are you using what you learned?

4. What kinds of support did I offer that helped you during the PBL sessions?

5. How could I improve my support as a facilitator?

6. Let's relook at the Teacher Belief Vignettes. Circle if you strongly agree, agree, feel neutral, disagree or strongly disagree that the vignette describes your beliefs.

7. Please tell me more about your beliefs for each vignette.

APPENDIX I

Johnston et al.'s (2001) Adapted Teacher's Beliefs Questionnaire

Directions: There are no right or wrong answers to the following questions. I want to know what you really believe. For each statement, circle the number that represents the degree to which you agree or disagree.

Strongly Disagree   **Strongly Agree**

| **1** | **2** | **3** | **4** | **5** |

	1	2	3	4	5
1. My role as a teacher is to help students become better thinkers.	1	2	3	4	5
2. I try to ask my students questions that either has a right or wrong answer.	1	2	3	4	5
3. My role is to provide students content/facts and correction of errors.	1	2	3	4	5
4. I like to give my students access to multiple sources of information even it conflicts, contradicts, or interferes with learning.	1	2	3	4	5
5. I believe students learn much better in groups than by working individually.	1	2	3	4	5
6. Student interactions among themselves are a valuable tool for learning.	1	2	3	4	5
7. Controversial issues should be avoided in the classroom setting.	1	2	3	4	5
8. The primary focus of teaching is to help students acquire specific knowledge to be memorized and used later.	1	2	3	4	5

THANK YOU!

APPENDIX J

School Site Authorization Letter

July 13, 2015

██████████████

██████████████

Dear Human Subjects Committee:

It is my understanding that Ms. Michaela Jacobsen will be conducting a research study at ██████████ Elementary School on "A Mixed Methods Multi-Case Study of a Problem-Based Learning Approach to Teacher Professional Development." Ms. Michaela Jacobsen has informed me of the design of the study as well as the targeted population.

I support this effort and will provide any assistance necessary for the successful implementation of this study. If you have any questions, please do not hesitate to call. I can be reached at

Sincerely,

[signature]

██████████████

Principal, ██████████ Elementary School

APPENDIX K

Jacobsen IRB Approval Letter

PEPPERDINE UNIVERSITY

Graduate & Professional Schools Institutional Review Board

September 4, 2015

Michaela Jacobsen

███████████

Protocol #: E0715D07
Project Title: A Multi-Case Study of a Problem-Based Learning Approach to Teacher Professional Development

Dear Ms. Jacobsen:

Thank you for submitting your application, *A Multi-Case Study of a Problem-Based Learning Approach to Teacher Professional Development*, for exempt review to Pepperdine University's Graduate and Professional Schools Institutional Review Board (GPS IRB). The IRB appreciates the work you and your faculty advisor, Dr. Judith Fusco Kledzik, have done on the proposal. The IRB has reviewed your submitted IRB application and all ancillary materials. Upon review, the IRB has determined that the above entitled project meets the requirements for exemption under the federal regulations (45 CFR 46 - http://www.hhs.gov/ohrp/humansubjects/guidance/45cfr46.html) that govern the protections of human subjects. Specifically, section 45 CFR 46.101(b)(1) and (2) states:

> (b) Unless otherwise required by Department or Agency heads, research activities in which the only involvement of human subjects will be in one or more of the following categories are exempt from this policy:
>
> **Category (1) of 45 CFR 46.101**, research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (a) research on regular and special education instructional strategies, or (b) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
>
> **Category (2) of 45 CFR 46.101**, research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: a) Information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and b) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

Your research must be conducted according to the proposal that was submitted to the IRB. If changes to the approved protocol occur, a revised protocol must be reviewed and approved by the IRB before implementation. For any proposed changes in your research protocol, please submit a **Request for Modification Form** to the GPS IRB. Because your study falls under exemption, there is no requirement for continuing IRB review of your project. Please be aware

APPENDIX L

Codebook

Code	Definition of Code
Stage 1 - Agreeing upon or coordinating actions	Joint assistance. Working cooperatively to solve a problem/goal.
Stage 1 - Attention on a small portion of the capacity to be acquired	Learner is focused only on one part of the activity or a sub-goal. Does not conceptualize the overall goal of the activity.
Stage 1 - Change of Value	Learners incorporate the value and meaning of the activity.
Stage 1 - Constructing Meaning	Learner constructs meaning based on assumptions, knowledge, and personal experiences.
Stage 1 - Intersubjectivity achieved	Learner has conceptualized the true goal of the activity. Develops a common understanding of the purpose of the activity.
Stage 1 - Negotiation of goals	Mutually (learner and capable other) choosing goals for development.
Stage 1 - Operates now as own consultant	Learner takes responsibility for task performance. He/she is no longer reliant on assistance by the capable other.
Stage 1 - Operates on old scripts, attempts residual and possibly competing skills	Learner is not congruent with the goals of the activity.
Stage 1 - Questioning	Learner asks for strategic direction or help.
Stage 2 - Developing standards	Identifying the necessary components of a goal.
Stage 2 - Envisioning models of good solutions to problem	Identifying solutions to problems encountered that are aligned with the goal.
Stage 2 - Instructing self	Assists self with task

Stage 2 - Seeking and constructing cognitive structures to explain	Uses Whimbey book to explain experiences.
Stage 2 - Self-talk	Self-instruction, self-praise, self-scolding, self-questioning.
Stage 3 - Assistance no longer needed and is disruption	Performance becomes internalized and automized
Peer Coaching	Calling on Individuals
Peer Coaching	Checking for interpretation
Peer Coaching	Clarifying ideas
Peer Coaching	Cognitive Structuring
Peer Coaching	Connecting to practice
Peer Coaching	Contingencies: praise and encouragement
Peer Coaching	Encourages persistence
Peer Coaching	Feedback
Peer Coaching	Instructing
Peer Coaching	Modeling
Peer Coaching	Pushing for elaboration
Peer Coaching	Questioning
Transmissionist Epistemology	A person who believes that knowledge is transmittable, fixed, quickly learned, simple, and isolated bits of information
Contextualist Epistemology	A person who believes that knowledge is complex, subject to change, learned gradually, and is constructed by the learner
PBL effective for improving skills/practice	PBL produces desired result
PBL ineffective for improving skills/practice	PBL does not produce desired result
Motivation engagement	Initiative to continue a task without encouragement.

Students Capable	Students are ready for higher order thinking tasks and are capable of engaging in the TAPPS method.
Students Incapable	Students are incapable of moving past the beginning simpler stages of the learning process.

APPENDIX M

Adapted Teacher's Beliefs Questionnaire: Participants Responses and Mean

Johnston et al.'s (2001) Adapted Teacher's Beliefs Questionnaire Participant Responses				
Statements	Carl	Larry	Sandy	Mean
1. A teacher's role is to help students become better thinkers.* Strongly Disagree Agree 1　2　3　4　5	4	5	5	4.5
2. I ensure the questions I ask of my students have either a right or wrong answer Strongly Disagree　　　Strongly Agree 1　2　3　4　5	3	3	2	2.67
3. A teacher's role is to provide students content/facts and correction of errors. Strongly Disagree　　　Strongly Agree 1　2　3　4　5	4	4	3	3.67
4. I prefer to give my students multiple, and possibly conflicting, sources of information.* Strongly Disagree　　　Strongly Agree 1　2　3　4　5	2	2/3	4	2.83
5. Knowledge is rarely simply right or wrong.* Strongly Disagree　　　Strongly Agree 1　2　3　4　5	4	3/4	4	3.83

6. Student discussion and interactions among themselves is a valuable tool for learning.*

      Strongly Disagree   Strongly Agree

       1   2   3   4   5   4   3/4   5   4.17

7. I prefer to avoid controversial and complex issues in my teaching.

      Strongly Disagree   Strongly Agree

       1   2   3   4   5   3   3   2   2.67

8. Teaching should emphasize facts and memory.

      Strongly Disagree   Strongly Agree

       1   2   3   4   5   3   2/3   3   2.83

* Contextualist Statements

APPENDIX N

Permission to Use Hmelo-Silver's (2004) *The PBL Learning Cycle Figure*

From: Cindy Hmelo-Silver chmelosi@gmail.com **Subject:** Re: The PBL Learning Cycle

Date: May 7, 2015 at 8:57 AM **To:** shessj@gmail.com

Hi Michaela,Thanks for your interest in my work. You have permission to use the figure.

Best wishes,

Cindy Hmelo-Silver

On Wed, May 6, 2015 at 11:09 PM, <ets@indiana.edu> wrote: ***Please note***

This email was sent by an online form and the identity of the sender cannot be verified because this is a public anonymous form. The sender indicated the following contact information:

Email Address: shessj@gmail.com First Name: MichaelaLast Name: Jacobsen

The comment/inquiry follows: Hi Dr. Hmelo-Silver,

I am writing my dissertation on PBL as an approach to teacher professional development. I would like to ask your permission to use your figure, "The PBL Learning Cycle," located on page 237 of your 2004 paper. May I have permission to use?

Sincerely, Michaela Jacobsen

--Cindy Hmelo-Silver chmelosi@indiana.edu

Professor, Learning SciencesDirector, Center for Research on Learning and Technology Indiana University | School of Education1900 East Tenth Street | Bloomington, Indiana | 47406-7512 Room 543 | 812-856-8335| www.crlt.indiana.edu Past President, International Society of the Learning Sciences

Follow us on twitter: https://twitter.com/iubcrlt

New Book: **Essential Readings in Problem-Based Learning: Exploring and Extending the Legacy of Howard S. Barrows** Andrew Walker, Heather Leary, Cindy E. Hmelo-Silver and Peggy A. Ertmer, Editors. http://www.thepress.purdue.edu/titles/format/9781557536822