IMPLEMENTING PROFESSIONAL DEVELOPMENT IN SCIENCE USING COACHING:
AN ACTION RESEARCH STUDY

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Implementing Professional Development in Science Using Coaching:

An Action Research Study

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ABSTRACT

This action research utilized a mix method approach where qualitative and quantitative data were collected. The research study sought to explore if sustained professional development through coaching was done with teachers to enact problem-based learning would transform teachers’ praxis. In addition, the researcher examined what were the factors that contributed to teachers’ inability to transfer learning from a traditional workshop setting to implementing the knowledge gained to their classrooms. The action research consisted of two major stages, namely the needs assessment and the action research cycle. It was imperative that the researcher explore the local setting to ascertain the perceptions of teachers and look at data to determine the needs. From the needs assessment the researcher co-constructed and implemented an intervention to train teacher-participants about problem-based learning as well as conducted awareness sessions about peer coaching and what should be expected during the research study.

The researcher collaborated with teacher-participants during the coaching model as they embraced co-planning, modelling, and guidance for enactment. Upon the completion of the intervention, the action research cycle began with teachers of science. Throughout the research study, a key feature was critical reflection by the teachers as well as the researcher. Students doing the problem-based learning cycles were encouraged to do reflection, as this was a best practice for problem-based learning theory. The researcher was guided by the review of the data in Iteration 1 to make adjustments for Iteration 2; data were further analyzed in Iteration 2 after the science participants were completed, this informed changes that were made in Iteration 3. The research concluded with an ethnographic reflection of the transformation process that indicated the use of coaching as a professional development initiative for the enactment of a new
instructional strategy. In addition, the overall effect that this had on the researcher’s praxis and research skills.

Keywords: Professional development, coaching, problem-based learning, transformative learning
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CHAPTER I: INTRODUCTION

In the educational arena, there is constant call for reform, improvement of teachers’ instructional practices, and new initiatives for improving students learning, achievement, and ultimately preparing them to be 21st century workers. Given the impact of the global market demand, educational leaders are given the mandate to create high-impact professional development/learning (Reeves, 2010). In this chapter, the researcher reviewed the background to the study, statement of the problem, purpose of the study, significance of the study, and operational definitions that are applicable to the research study.

Background of the Study

Policymakers, building principals, and other administrative personnel continuously look to professional development initiatives as a critical strategy for supporting and finding solutions for the complex needs of students (Luyten & Bazo, 2019; Zhao, 2010). The main reasons for this constant search are that teachers are required to prepare students for further education, learn content knowledge, and apply it to their daily lives and interaction. In addition, teachers are expected to train students so that they can become employable citizens in the 21st century and be able to compete in the global market. It is incumbent on all educators to seek new strategies to improve their instructional practice and develop better approaches for teaching content knowledge (Darling-Hammond et al., 2017; Peng et al., 2014).

Teachers are seen as a fundamental component in reforming the education system and, as a result, keen attention should be placed on appropriate and effective training of teachers (American Association of Colleges for Teacher Education (AACTE), 2016; AACTE, 2019). Sometimes, teachers do not naturally have the essential competencies, skills, and abilities to perform the duties that are required of them and, therefore, job-embedded high-quality
professional learning is imperative (Reeves, 2010). Teacher professional development (TPD), with the appropriate pedagogical innovations, relies on the teacher’s understanding of what is and how it can be adapted in the local conditions (AACTE, 2019). This adaptation is sometimes not evident, hence the need for training through professional development series.

The problem is that, there is almost no opportunity for teachers to engage in continuous and sustained learning about their practice in the settings in which they actually work, observing and being observed by their colleagues in their own classrooms and classrooms of other teachers in different schools that are confronting similar problems. (Fullan, 2007, p. 127)

Professional development for teachers strongly influences their effectiveness and retention in the classroom (AACTE, 2016). Therefore, the researcher sought to examine if the implementation of professional development in science using coaching would positively impact science teachers’ instructional practice and if it would lead to greater student learning and transformation of teachers’ teaching practice.

**Statement of the Problem**

Governmental bodies, business groups, researchers, and different commissions report that the central and critical role that professional development plays in school reform is imperative (Diaz-Maggioli, 2004; Reeves, 2010; Sparks & Hirsh, 1997). Guskey (1986) further explains that high quality staff development is a central element in a district’s plan for improving education. An increase in staff development that enhances professional skills is essential because teachers remain in their positions for longer periods, with fewer new teachers entering the field. However, professional development that has been done in the traditional way over the years “has yielded little or no positive effects on student learning” (Diaz-Maggioli, 2004, p. 1). For decades,
professional development was seen as workshops, one day meetings or sessions where information was given and teachers were expected to implement these strategies in their classes. Research has shown that sustained implementation of professional development is needed to support reform. This will affect staff’s knowledge, attitudes, and practices (Sparks & Hirsh, 1997; Reeves, 2010). Diaz-Maggioli (2004) elucidates that, in an era of high-stakes testing and accountability, it is imperative that professional development is restructured to allow collective efforts of teachers, students and administrators to improve students’ learning and achievement.

Given this demand, the research study investigated the effects of peer coaching as a professional development initiative to improve the implementation of problem-based learning strategies in science and math classrooms.

At the school that the researcher conducted the research study, professional development sessions are conducted weekly for all teachers that include general education and special education teachers. These teachers teach middle and high school classes (Grades 7-12). However, this research study was focused on teachers in science and math that taught Grades 7-10. Based on experience and observation at the school as well as visits to classes, there are inconsistencies in the integration of new skills learned into the classes. In the past, three main constructivist-learning strategies have been presented in workshop settings. The training sessions included problem-based learning, project-based learning, and the utilization of web quest.

Teachers were encouraged to implement these in their instructional practice over a period. Upon observation and through departmental meetings with science teachers at the local setting, it has been noted that the strategies have not been implemented with fidelity in science classrooms. Project-based learning and web quest have been implemented by a few teachers. Based on the
researcher’s role as a part of the leadership team at the school, it is imperative that high-impact professional learning is embraced to ensure that students’ learning is improved.

According to Reeves (2010), high impact professional learning/development should be used in schools to effect change. A high impact professional development should include: (a) focus on students’ learning, (b) focus on people and practices, not programs, and (c) provide rigorous measurement of adult decisions. In this research study, the researcher guided science and math teachers using coaching as the professional development strategy with the intention that teachers’ instructional practice will be transformed.

**Purpose of the Study**

The main purpose of this action research study was to examine the effects of professional development in science when coaching is used. In addition, another purpose was to investigate if this approach to professional development can potentially lead to the transformation of teachers’ instructional practice. The instructional strategy that was used for the professional development intervention was problem-based learning. The research study was conducted at one charter school in Southern Connecticut where professional development needs and perceptions were explored. Initially, the researcher explored the local conditions to examine professional development needs, and the teachers’ ability to implement new initiatives after the completion of professional development (PD) workshops that were conducted by the school. In addition, the researcher explored what are teachers’ perceptions about the use of problem-based learning in improving students learning. Problem-based learning strategies were taught in professional development workshops but was not implemented by staff at the school. The research study sought to confirm whether, if professional development was implemented using coaching, if it would transform science teachers’ instructional practice. Another aspect that was explored was
to follow up with science teachers through class observations, interviews, and dialogue with the teachers, to assess the effectiveness of the implementation of the professional development intervention and the use of problem-based learning strategy. Finally, this action research study would improve the teacher-researcher’s own praxis.

**Significance of the Problem**

In the education field, one of the main aims is to improve students’ learning that will help them to develop critical skills, problem-solving skills, and be creative thinkers as they seek to compete in the global market (Diaz-Maggioli, 2004; Darling-Hammond et al., 2017). Two major areas that are often under review when the topics of students’ learning, students’ achievement and preparation of the 21st century worker are being discussed are education reform and preparation of teachers. Educators are constantly introduced to new and improved teaching initiatives that should be applied to instructional practices (The National Academics Press, 2019). However, very often, these are introduced in workshop-style training and teachers are then asked to implement the instructional strategies in their classrooms. In addition, curricula and teachers’ instruction are seen as core elements to students learning and education reform; these elements should always be treated as priority in schools (The National Academics Press, 2019).

As the science field continues to transition and evolve, new initiatives, different programs, and the quest for what really works in the classroom are expressed at various levels. In science, discovery learning is one strategy that is normally discussed when students’ learning and motivation are mentioned. The use of problem-based learning (PBL) dates back to Fall 1969, when it was first introduced at McMaster University School of Medicine (Servant-Miklos, 2016). Many studies have been done which show PBLs continued relevance and effectiveness in the science classrooms (Servant-Miklos, 2016). Problem-based learning is student-centered and
learning begins by using real life problems with small groups of students that will tackle the problem that is posed. This is guided by the teacher who became the facilitator of learning (Delisle, 1997; Servant-Miklos, 2016). To ensure that this strategy was applied to instructional practice, professional development for teachers became important. For effective professional development in science, promoting collaboration among teachers in the same school where issues could be connected and understood promoted active learning between staff members (Darling-Hammond et al., 2017; National Science Teachers Association (NSTA), 2019). This research study sought to promote professional development amongst teachers in the same school using their classroom setting. In addition, different researchers explicate that high-quality professional development creates the space and time for teachers to share ideas and collaborate in their learning which, over a period of time, improves instructional delivery (Darling-Hammond et al., 2017; Reeves, 2010). This research study examined the implementation of professional development in science classrooms using coaching and identified if there was transformation of instructional practice. The instructional strategy that was used for the professional development intervention was problem-based learning.

**Operational Definitions**

**Coaching:** Coaching is a process in which two or more educators work together to improve their practice. This involves teachers working to improve learning and development through increased self-awareness, personal responsibility through active listening, support, partnership, questioning, and mutual respect (Gibbons & Cobb, 2017; Knight, 2007; Knight & van Nieuwerburgh, 2012).

**Problem-Based Learning:** Problem-based learning (PBL) provides a structure for discovery that helps students internalize learning which leads to greater comprehension (Delisle,
1997). In this research study, problem-based learning involved students solving problems in the classroom and as a result was able to apply and learn science concepts. PBL strategy facilitated students’ collaboration, active engagement in the classroom as students’ co-construct knowledge with classmates in small work groups, using their background experiences, other resources that are available to them, and through experimentation.

**Transformative Learning:** This is the development through application of an individual’s basic worldview. It is a process of effecting change in a frame of reference when teachers interpret and reinterpret their experience, which is key to making meaning which leads to a changed behavior (Fazel, 2013; Mezirow, 1991).

**Transformative Learning Theory:** This is a theory of adult learning that involves deep and meaningful learning that goes beyond mere acquisition of content knowledge and supports different ways in which teachers can make meaning in their lives. This is done through reflection experience and dialogue. This converted challenging frames of reference for better comprehension (Mezirow, Taylor & Associates, 2009; Seel, 2012).
CHAPTER II: LITERATURE REVIEW

It is imperative that when a researcher decides to conduct a research study that a literature review is conducted. Creswell (2012) explains that it is important to do a review of literature to examine who has studied the problem that you plan to research. In addition, a review of literature is done to ensure that the researcher is not merely replicating a study that was done in the past (Creswell, 2012). In this chapter, the researcher reviewed literature in the main areas that were a part of the research study process and procedures. The topics to be discussed in the chapter include the science education reform, background to professional development, effective professional development, coaching as a professional development strategy, problem-based learning, transformative learning theory, and empirical research discussion. In addition, the research questions are outlined and it is indicated at what stages in the research study they will be explored.

Science Education Reform

Over the decades, there have been numerous changes to the science curriculum in the United States. The continual change of the curriculum seeks to respond to the demand for improvement of students’ learning and achievement in science to meet the demands of the global market and to prepare 21st century workers who are employable in the science field (National Academy of Sciences, 2015). Science reformation is now guided by the Framework for K–12 science education which calls for a different approach to teaching science. This framework includes the introduction of the Next Generation Science Standards (NGSS) (Connecticut State Department of Education, 2015; National Science Teachers Association, 2014). NGSS includes three dimensions of learning, which are: (a) cross cutting concepts, (b) scientific and engineering practices, and (c) disciplinary core ideas (Connecticut State Department, 2015; National
Academy of Sciences, 2015; National Science Teachers Association, 2014). With the adaptation of the use of NGSS in K-12 classrooms, there is the obvious need to change how science is imparted. The use of NGSS requires an adjustment of teaching approaches that will allow students to be immersed in doing science and to apply this knowledge in a holistic way (National Academy of Sciences, 2015).

What students need to learn in science is often inspired by high quality science teaching which is grounded in aspirations for students’ learning (National Academy of Sciences, 2015). Teachers’ teaching strategies are not shaped only by formal professional development sessions but also by teaching contexts, human resources, other resources that are available, polices, and educational reform initiatives (National Academy of Sciences, 2015). In addition, a teacher’s learning is also influenced by students and how much should be learned to meet students’ needs (National Academy of Sciences, 2015; National Science Teachers Association, 2014). Science teachers’ learning continuum differs in relations to their knowledge of the content, ability to impart the science content efficiently, pedagogical knowledge, and the years of experience that a teacher may have teaching the science subject. According to the National Academy of Science (2015), a science teacher who has been using a teacher-centered approach for a long time, when presented a change that introduces problem-based learning which student-centered, may feel inadequate and frustrated. With constant change in approaches to teaching science subjects, it is important that teachers are prepared to meet the new demands by being equipped with multiple instructional methodologies (National Academy of Sciences, 2015). For teachers to be prepared for the changes to be implemented in science classrooms, administrators and principals are encouraged to embrace professional or staff development in schools. Professional learning is aimed at supporting teachers in their daily instructional practices but very often this is reflected
only in PD workshops or sessions (Jackson, 1995; National Academy of Sciences, 2015). Substantial change in practice can be seen when there is embedded professional development which is situated in the context of the teacher’s practice (Fullan, 2015; National Academy of Sciences, 2015; Showers & Joyce, 1996). It is therefore important to investigate the effects of implementing professional development in science classrooms using coaching.

**Background of Professional Development**

The field of education continues to evolve as pedagogical approaches change and the demands on a teachers’ instructional practice needs adjustment over a period of time (Guskey, 2000). This evolution has been caused by numerous reasons, but one key cause is the increasing demand for accountability with fewer financial resources for schools to utilize. Administration and teachers are encouraged to embrace professional development so that teachers can improve their instructional practices, remain current, and increase students’ learning (Martin et al., 2014). In addition, there is a constant call for education reform and improvement of the education system; this includes the improvement of content delivery and implementation of new and effective pedagogical strategies. With the continuous reform efforts in science education and the United States education system in general, various challenges have been presented (Martin et al., 2014). Some challenges that are presented are the change in teaching delivery, high budgets to maintain staff developments and change in curricula. These changes in education are normally driven by an alteration of government policies to involve different movements. Some of the reform movements include the Sputnik era, a nation at risk project in 1957, No Child Left Behind Act (NCLB) in 2002, Common Core State Standards (CCSS) in 2009 and Next Generation Science Standards in 2013 (Connecticut State Department of Education, 2015; Martin et al., 2014; National Science Teachers Association, 2014). Over the years, it has been
noted that as the education initiatives are introduced, new training models, workshops and seminars are adopted to help with the implementation of these initiatives in schools. This is normally done through professional development series and sessions (Martin et al., 2014). These approaches vary and are sometimes viewed as whole-school reforms and schools are expected to make changes to their operational system, while teachers engaged in professional development. In addition, it was anticipated that adjustments for instructions in the classroom would be made almost immediately upon completion of the professional development sessions (Martin et al., 2014). In most scenarios, secondary teachers are asked to consider interdisciplinary curricula and at the same time they are asked to reconsider the new approaches to teaching that have been handed down to them through whole-group seminars also referred to as professional development interventions (Martin et al, 2014). This is whole-group sessions are sometimes viewed as a counter-productive effort for the effective transfer of learning and implementation in the classroom. As a result, this research study examined if this is changed to sustained professional development how it would affect teachers’ ability to implement new instructional practices in their classroom.

Professional development is the main vehicle for education to provide relevant teaching skills and to enhance pedagogical knowledge of teachers in order to improve students’ learning and critical thinking skills (Guskey, 2000). According to Díaz-Maggioli (2004), professional development can be defined as a “career-long process in which educators fine-tune their teaching to meet students’ needs” (Díaz-Maggioli, 2004, p. 5). Professional development in the educational arena has been criticized for their high cost and lack of continuous support during implementation for further professional pursuit of teachers. Hence, professional development when done as workshops, conferences, seminars and observational visits has been viewed as
being ineffective (Little, 1993; Martin et al., 2014; Martin & Mulvihill, 2017). “Teachers grow, evolve, and emerge throughout their careers and the day-to-day work they do, and that is why job-embedded learning opportunities need to be the focal point” in a school (Zepeda, 2014, p. 1). Effective professional development is a job-embedded commitment to learning that is structured (Diaz-Maggioli, 2004; Zepeda, 2014). Zepeda (2014) explicates that teachers should be a part of a community that embraces different viewpoints, varied experiences and support that can be had from colleagues through collaborating and working together to experience change in instructional practices. This will result in the change of teachers’ praxis and improves students learning (Darling-Hammond et al., 2017; Diaz-Maggioli, 2004). The research study examined the implementation of professional development in science using coaching. The researcher used sustained professional development to guide the enactment of problem-based learning instructional strategy in science classrooms and to examine if teachers’ instructional practice is transformed.

**Effective Professional Development**

According to Darling-Hammond and Richardson (2009), most teachers who experience professional development do so only through traditional workshops even though they have been found to be ineffective. The writers explain that the aim of these sessions is to transfer the knowledge learned to teaching practice (Darling-Hammond & Richardson, 2009). In addition, “90 percent of teachers participate in workshop-style training sessions during a school year” (Darling-Hammond & Richardson, 2009, p. 2). While continual learning is important in the lifelong pursuit for educators, Zepeda (2014) explains, that it is the quality of the professional learning that matters; this ensured learning across the span of people’s career. There is a direct
link between the type, intensity, and duration of professional learning that is imperative to teacher effectiveness and students’ learning (Showers & Joyce, 1996; Zepeda, 2014).

For many years, the question has been asked about what constitutes effective professional development. Effective professional development is when teachers have an active role in constructing knowledge and collaborate with colleagues through critical reflection and action (Sparks & Hirsh, 1997; Zepeda, 2014). In addition, professional development that is deemed effective should be content related and situated in the daily practice and differentiated to the teacher’s professional needs (Sparks & Hirsh, 1997; Zepeda, 2014). Many authors have tried to categorize and describe the main features of effective professional development and the features vary from one author to the next (Darling-Hammond et al., 2017; Guskey, 2009; Martin et al., 2014; Rhoton & Shane, 2001). However, Darling-Hammond et al. (2017) explicate that there are seven main features that are used to assess the effectiveness of professional development; they are: (a) content-focused, (b) involve active learning, (c) are of sustained duration, (d) provide coaching and expert support, and (e) create collaboration. In addition, other features include: (f) offering feedback and reflection and (g) utilizing different models of practice (Darling-Hammond et al., 2017). For professional learning effectiveness, when training teachers it would be expected that all or most of these elements are evident. In addition, most of these elements can also be identified in the transformative learning theory (TLT). This theory will form the foundation for evaluation for teachers’ transformation (Mezirow & Taylor, 2009).

A key element to effective professional development is through the use of job-embedded learning for teachers (Sparks & Hirsh, 1997). Job-embedded learning links learning to the immediate and real-life challenges that are being faced by teachers. It is response to challenges that are immediately being faced by students and allows for immediate application,
experimentation, collaboration between colleagues, and adaptation on the job (Sparks & Hirsh, 1997; Zepeda, 2014). In the research study, professional development was implemented in science classrooms through coaching for a period of four months. This sustained professional development supported teachers as problem-based learning was implemented in the science classroom. For effective professional development, there should be a sustained duration over a period of time as the participants and researcher had enough time to learn, practice, and implement what was learned in the science classroom and reflect on the new strategy (Darling-Hammond et al., 2017). This was done through teamwork between the teacher-participants and the researchers as they actively planned lessons, and implement problem-based learning strategies together. The coaching model utilized dialogue, collaboration, critical reflection, prior experience, and an awareness of the teachers’ context (Darling-Hammond et al., 2017; Mezirow, 2009; Showers & Joyce, 1996; Zepeda, 2014). Robbins (2015) explains that coaching is a good tool for coworkers to sharpen their skills, and to get them to benefit from each other to improve their instructional practices that will, over time, impact students’ learning positively.

Coaching

Coaching is viewed as a major catalyst for change that has been used in the educational arena for improvement of instructional practice and students’ success. Joyce and Showers (1995), in their seminal research indicate that planners of professional development should design staff training which provides worthwhile opportunities for teachers to enhance their knowledge and skills. Joyce and Showers (1995) explain that this training should be done through coaching of teachers in their own classroom environment which would be content specific. Educational coaching is defined as a process that is used to partner with teachers for job-embedded professional learning that improves the teacher’s understanding of the
curriculum, students’ needs, and pedagogy for the purpose of addressing problems that obstruct teachers’ success (Diaz-Maggioli, 2004; Morel, 2014; Toll, 2018). Coaching is designed to give support, guidance and assistance to enable teachers to refine their present skills, solve classroom-related problems and to acquire new skills and competencies (Diaz-Maggioli, 2004; Showers, 1984; Showers & Joyce, 2002). The implication and exploration of coaching as a model involves joint planning, resource development, mutual observations, critical reflection, and feedback which are all key elements as teachers learn from each other (Showers & Joyce, 2002). The research study will use coaching as a form of professional development to provide support to science teachers using prior experience, coaching techniques such as modeling and reflection. In addition, coaching will be used to provide feedback as science teachers implement problem-based learning instructional strategies in their classrooms.

The peer-coaching model was embraced and utilized in the research study. The coaching process incorporated the model where teachers collaborated together to plan lessons using specific pedagogical approach for implementation, observation of a lesson and feedback which was provided through reflection and improved teachers’ practice (Morel, 2014; Robbins, 2015). Peer coaching incorporates different forms such as collaborative work and formal coaching (Robbins, 2015). In collaborative form of peer coaching is when two or more professional colleagues are engaged in informal interactions with a specific focus; however, classroom observations are not done (Robbins, 2015). Formal or expert coaching on the other hand, involves pre- conference, classroom observations and post-conference (Diaz-Maggioli, 2004; Robbins, 2015; Zepeda, 2014). According to Robbins (2015), peer coaching includes two or three teachers and sometimes it may be a team; this may happen between teachers of different experience levels who are working together to close students’ achievement gap and to improve
instructional practice. Peer coaching using the formal model was employed in the research study and the researcher will provide sustained professional development in the form of coaching to science teachers at one charter school in southern Connecticut. Problem-based learning was implemented in Grades 7 to 10 science and math classrooms using this professional development framework (coaching). According to Showers (1984) in a seminal research, *Teachers Coaching Teachers*, there are numerous benefits to be derived when coaching is implemented in the classroom. Some benefits that were outlined include the building of a community of teachers who continuously share in improvement of their pedagogical skills. Secondly, coaching formulates shared language and common understanding that is necessary for collegial study of new knowledge and skills. Thirdly, coaching provides the framework that is needed for future training and for acquisition of new skills and knowledge (Showers, 1984). The researcher sought to embrace these key benefits of coaching and encouraged greater teacher collaboration amongst science and math teachers at the school in southern Connecticut.

In *A Synthesis of Research on Staff Development: A Framework For Future Study And A State-Of-The- Art Analysis* (Showers et al., 1987), a meta-analysis of over 200 research studies were reviewed with the aim of assessing findings to provide a solid framework for program design to be utilized for training teachers. In addition, the meta-analysis was used to organize literature that was already in the field about staff development and to provide cumulative research that can be used by present researchers to build on (Showers et al., 1987). One main highlight from the meta-analysis of research studies indicated that teachers are more likely to keep and use the new strategies and concepts that are learned in professional development if coaching is received (Showers et al., 1987). Shower et al. (1987) elucidate that coaching can be from experts or peers as teachers implement the new strategy in the classroom. In the research
study, professional development using peer coaching was used with science and math teachers to implement problem-based learning strategy in science and math classrooms. Through peer coaching, shared learning processes were encouraged which directly improved students’ learning (Showers & Joyce, 1996).

**Background of Problem Based Learning**

Problem-based learning (PBL) is viewed as a theory as well as a teaching strategy and can be dated back to the 1950’s (Delisle, 1997; Fredrickson et al., 2013). In this research study, problem-based learning as an instructional strategy was implemented in science and mathematics classrooms using professional development. Problem-based learning is student-centered, and the teacher acts as a facilitator of learning. PBL as an instructional strategy is a multi-faceted approach that uses complex problems in order to find solutions and it is multidisciplinary in nature (Colliver, 2000; Delisle, 1997; Fredrickson et al., 2013). A multidisciplinary approach is one that focuses on integration of different disciplines and perspectives to illustrate a topic, problem or theme to be discussed (International Bureau of Education, 2019). The problem-based approach to facilitating learning for medical students started in the United States at the University of New Mexico in 1979 (McCormick Peterman, 2012). Problem-based learning is recognized as a constructivist learning theory (Narayan et al., 2013). Constructivism postulates that human knowledge is actively constructed by individuals, based on previous experiences, whether individually or within social communities (Narayan et al., 2013; Phillips, 1995). This theory can be traced back to the 18th century where the belief was expressed that humans could comprehend only what was constructed by them (Narayan et al., 2013). Among the founding thinkers of this theory are Jean Piaget, John Dewey, Jerome Bruner and Lev Vygotsky; John Dewey, believed that education relied on action (Narayan et al., 2013).
Also, John Dewey believed that construction of meaning in different situations was mental and children should be provided with various activities that are engaging for their hands and minds (Narayan et al., 2013).

Constructivism includes different models and principles of learning that includes discovery learning, which consists of simulation-based learning, problem-based learning, guided discovery, and incidental learning (Narayan et al., 2013; University of Sydney, 2019). In addition, when using discovery-learning approach, students are placed in problem-solving situations where they are expected to use prior knowledge, experiences and existing knowledge to identify facts and new details (Narayan et al., 2013; University of Sydney, 2019). Problem-based learning (PBL) provides a structure for discovery that assists students to internalize learning that will provide better comprehension for the content that is being taught (Delisle, 1997).

The foundation of problem-based learning dates back as early as the 1950’s to the medical field at McMaster University in Canada (Fredrickson et al., 2013; McCormick Peterman, 2012). This instructional strategy was a model that was used where essential medical science was learned through the analysis of typical medical cases. Problem-based learning approach was originally developed to respond to criticisms that indicated that traditional teaching and learning approaches were not adequate to prepare medical students for solving problems that they faced in their clinical settings (Hung et al., 2008). At the University of New Mexico, teaching was introduced in the form of a learning track in which students could select learning through the student-centered approach, which was called problem-based learning (McCormick Peterman, 2012). Instead of having students study the content of the concepts to be learned, they practiced with content-free problems and problem-based learning processes using real-life
problems were then introduced (Fredrickson et al., 2013; Hung et al., 2008; McCormick Peterman, 2012).

**Problem-Based Learning Strategy**

Problem-based learning has been used in science classrooms for many years as a teaching strategy that has improved students’ learning and achievement (Servant-Miklos, 2018). This learning strategy has positively influenced students’ critical thinking skills and improved problem-solving skills as learners work through various science content (Delisle, 1997). In the research study, science teachers implemented PBL when coaching was provided; it allowed the teacher-researcher to examine if teachers’ praxis is transformed.

Numerous tenets underline the use of problem-based learning in the classroom. Important components of problem-based learning include the educator having an instructional unit that has an authentic, ill-structured problem. This means that there is no single process that is deemed correct when students are solving problems (Delisle, 1997). Another key component is that, the teacher acts as a facilitator of learning and guides students through the process for task completion. Using this approach, students assume ownership of their learning and are given the responsibility to find an appropriate solution for the problem that is given (McCormick Peterman, 2012). The problems that are given to students should be appropriate to students’ real life experiences (Gallagher, 1997; Hung et al., 2008; McCormick Peterman, 2012). In addition, the ill-structured problem that is set for students should be challenging enough to match their skills and competencies (McCormick Peterman, 2012).

Another major tenet of problem-based learning is collaboration. This is when the problem that is assigned by the teacher is solved in small groups. Collaboration is also embraced by transformative learning theory that was first by Mezirow et al. (2009). This involves, learning
issues or tasks are disseminated among the groups and they report with the results of their research (Gallagher & Stephen, 1996). When this is done, team skills are developed, negotiation of actions, resolving differences and problem solving are experienced and seen in action. Students are encouraged to use their metacognitive skills to be effective problem-solvers. In addition, student groups are encouraged to plan and monitor their learning so that success can be achieved (Schoenfeld, 1985). Facilitators are encouraged to guide students in their exploration of the problems to be solved. Savery (2006) explicates that students who are engaged in PBL over a period of time become self-directed in learning. In addition, students who engage in problem-based learning are encouraged to apply their new knowledge to complex problems, reflect on what is learned and utilize effective strategies (Savery, 2006). It will be important that the teacher-researcher who will serve as coach during this research study will guide the science teachers how the tenets can be used in different instructional lessons. In addition, the goals of problem-based learning are both knowledge-based and process-based and students should be regularly assessed in both dimensions (Savery, 2006). Assessments will be done by the science teachers during the research study in the action research cycle while the intervention and enactment processes are done. Research studies have shown that PBL promotes students’ learning of content, concepts, and principles as opposed to direct instruction and traditional methods (Duch et al., 2001; Illinois, Center for Innovation in Teaching & Learning, 2019).

**Transformative Learning Theory (TLT)**

In the educational arena, theory plays a critical role in how we assess a topic that is of concern. Theoretical knowledge helps people to explain the causal connections between empirical phenomena (Beista, 2012). Theory will also become the tool for comprehending why people say what they say and do what they do (Beista, 2012). In the research study, theory will
form the conceptual framework which has guided the creation of the research questions and research design to be used for the study. In addition, theory will guide collection and analysis of data using the main constructs for coding the qualitative data. The roles will be further explained in details in other sections of the research study.

The theory that framed the research study is transformative learning theory. This theory was developed by Mezirow in 1978 to examine how adults make sense of their experiences in life (Taylor, 1997). The needs assessment stage of this research study will seek to uncover teachers’ perceptions about professional development that is done with science teachers and how this impacts the direct transfer to instructional practice. Transformative learning theory (TLT) was initially introduced as an adult learning theory, which is still used in education as a great way to understand how adults learn (Dirkx, 1998; Taylor 2007). Transformative learning theory focuses on the transformation of practices as a result of learning in adulthood. It is the process of effecting change in a given frame of reference (Cherrstrom et al., 2013; Fazel, 2013; Mezirow et al., 2009). The second stage of this research study involved an action research cycle. The researcher examined if the professional development strategy was effective and has created transformation in the science teacher’s praxis. Transformative learning changes the way individuals think about themselves and their world and when applied, it can create a transformation in practice (Mezirow, 1978). Transformative learning theory maintains a diversity of approaches that are critical to the complexity of adult education, which varies depending on the setting and purpose (Taylor & Cranton, 2012). In the research study, transformative learning theory guided the professional development activities for science teachers as they implement problem-based learning strategies in their classrooms.
The founder of transformative learning theory, Jack Mezirow, elaborated on the theory in 1978 and continued to refine this theory for a number of decades. Initially, transformative learning theory was known as perspective transformation because Mezirow’s belief was that transformative learning involves a frame of reference that consists of habits of the mind and perspective meaning (Kitchenham, 2008; Mezirow, 1978; Taylor, 2007). Mezirow (2009) describes transformative learning as a critical dimension of learning in adulthood that enables people to recognize, reassess, and modify the structure of beliefs and expectations which influence one’s thinking, impressions, feelings and attitudes. Mezirow (1978) conducted a qualitative research study with 83 women who were returning to college after a long period of time. The participants were from 12 different re-entry programs. The purpose of the study was to, “identify factors that characteristically impede or facilitate the progress of these re-entry programs” (Mezirow, 1978, p. 6). The research study that was conducted by Mezirow (1978) concluded that the participants had experienced a perspective transformation and ten phases were identified. The findings from the research also indicate that when women returned to study it often leads to consciousness awareness and that process occurred in 10 steps. These steps include, a disorientating dilemma, self-examination, critical assessment of assumption, recognition of a connection between one’s discontent, and the transformation process. Also, exploration of options for new roles, relationship and action, planning a course of action, getting the required knowledge and skills and building competences and self-confidence which provides integration into one’s life on the basis of a new perspective (Badara, 2011; Christie et al., 2015; Mezirow, 2009). In addition, the research study indicated that women attending higher education had an inclination to follow this pattern of transformative learning (Mezirow, 1978; 2009). Transformative learning theory, allows learners to experience transformation by changing their
beliefs, attitudes, and participate in critical reflection. Critical reflection involves evaluation of the assumptions on which one’s beliefs are built (Mezirow, 1991). In the research study, critical reflection will be done by the teacher-researcher at the exploratory phase. In the action research stage when the intervention was enacted, critical reflection was done by participants and the teacher-researcher at all steps during the process. This will encourage the participants to guide or revise their interpretation of the meaning of an experience which guides subsequent understanding, appreciation and adjustment of practice. This will help to evaluate if transformation has occurred (Mezirow, 1991).

Transformative learning theory was originally guided by three core elements: individual experience, critical reflection, and dialogue (Mezirow, 2009; Taylor, 2007). However, as the theory was developed, other constructs were added, which now form the framework for the theory. The research study utilized the three main core elements during the two main stages of the process. At the intervention stage when the professional development for teachers will be done as well as the enactment of the instructional practice, these core elements were evident. The teacher-researcher in collaboration with the participants will use prior knowledge in the training and implementation process. Reflection and dialogue between the teacher-researcher and teacher-participants were evident during the action research cycle.

According to Mezirow (2009), the major TLT tenets include: (a) individual experience, which takes in account the teachers’ prior experience and what is experienced in the classroom and (b) promotion of critical reflection, which is imperative in fostering transformative learning. This involves the questioning of the integrity of deeply held assumptions and beliefs due to experiences in the past. Dialogue is viewed as a core element of transformative learning theory. Dialogue is the main medium through which transformation is promoted and developed. In
addition, other tenets are (c) Holistic orientation, which encourages other ways of knowing the affective and relational, (d) awareness of context, which deals with the development of a deeper appreciation and understanding of the personal and socio-cultural factors that influence transformation, and (e) authentic relationships which refer to establishing meaningful, genuine relationships with learners (Mezirow, 2009). The major tenets will serve as a guide to frame the process in the action research as professional development through the use of TLT will guide critical reflection. In addition, dialogue and individual experience will create an awareness of the phenomenon to be studied. Authentic relationships will be established as the science teachers will work together through sustained professional development and to implement problem-based learning in science classrooms.

In, An Update of Transformative Learning Theory: A Critical Review of the Empirical Research (1999–2005) (Taylor, 2007), the purpose of the research study was to capture new information on the theory as the last update was in 1998 and mostly found in unpublished dissertations. The paper reviewed 41 research studies that were published in peer-reviewed journals (Taylor, 2007). The forty-one peer-reviewed journal studies were reviewed, with most researchers using Mezirow’s concept of transformative learning theory as the theoretical framework. Taylor (2007) found that most researchers used a qualitative research design which is akin to the framework that was used by Mezirow in 1978. In the meta-analysis and update by Taylor (2007), the main findings indicate that the most significance found in the review of journal articles was that there is greater attention given to the practice of fostering transformative learning in higher education classrooms or in a workshop setting. The research study will take place in the secondary school setting; this includes Grades 7 through 10; sustained professional development will be used to implement the problem-based learning instructional strategy.
Transformative leaning theory and its tenets were evident through the iterations during the intervention as the researcher guided science teachers through reflective practice, the use of individual experience and continued dialogue throughout the research process.

In the research study conducted by Badara (2011), *Using Transformative Learning Theory to Investigate Ways to Enrich University Teaching: Focus on the Implementation of Student-Centered Teaching in Large Introductory Science Courses*, TLT formed the theoretical framework. The theoretical framework was used to explore science instructors’ conceptions about different approaches to teaching large science courses that were combined with their teaching practices. Professional development in the form of a workshop was done; this professional development was guided and framed by transformative learning theory (Badara, 2011). Eighteen faculty who taught science in large introductory courses participated in the workshop. Badara (2011) explicates that the research methodology that was used employed a multiple case study design, in which three cases were used. This qualitative research was facilitated through the use of reflection and dialogue in three stages: the pre-program stage, program stage, and the post-program stage. Transformative learning theory was used to guide the design of the study, for the formation of the research questions, collection and analysis of data (Badara, 2011). The research study is similar to the one that was conducted by Badara (2011). In the action research cycle of the research study, professional development intervention in the form of a workshop and enactment of a new instructional strategy were done. The intervention was framed by transformative learning theory. This was evident as the core elements of individual experience, dialogue and critical reflection will be done throughout the process of Iterations 1 and 2. Professional development was done using coaching over a period of 4 months in science classrooms.
Empirical Research

Transformative learning theory was used as the theoretical framework in numerous research studies in higher education, the medical field, educational organizations, and coaching. These research studies have added to the theoretical underpinnings of how people create, transfer, and apply new knowledge. In addition, this body of research serves as a guide for future researchers who will seek to employ transformative learning theory in their research studies.

Sammut (2014) conducted a research study on, *transformative learning theory and coaching: application in practice*, with eight participants who served as coaches over a period of two years. The coaches’ area of specialties ranged from business, leadership, life coach, and leadership coach. The study lasted for six weeks and participants were selected using purposive sampling technique. The purpose of the study was to discover if and how transformative learning theory is applied to coaching. The research study employed a qualitative research design. Data were collected through semi-structured interviews, observation, and audio recording; the audio recordings were then transcribed. The researcher used participants to do member check to ensure their responses were accurately represented and to increase internal validity of the study. Initial codes were identified from the data analysis process from the participants’ interview responses, and the final responses were further re-grouped using four TLT themes. The themes that were used include: space and context of the coaching environment, learning and coaching relationship, and dialogue, that is, language, and communication, and transformation.

Participants were asked about their experiences as peer coaches, as well as being a coached as teachers. Six of the 11 questions used by the researcher for the interview focused on core areas of coaching that were connected to transformative learning theory. These are: experience, critical reflection, dialogue, and holistic experience. One major finding was that, in
a coaching relationship, the clients are in charge of their own agenda and adults learn more effectively in coaching because they can create their own forward movement instead of being told what to do (Sammut, 2014). Sammut (2014) found that there is a direct link between coaching and adult learning and more specifically Mezirow’s six core elements of transformative learning theory. The six core elements as outlined by Mezirow (2009): individual experience, critical reflection, dialogue, holistic orientation, awareness of context, and authentic relationships were all actively used by coaches even though they were not aware that they were doing this (Sammut, 2014). This research study also explored and from data collected, it revealed that these six core elements were seen throughout the action research cycle.

One major weakness that was found in this research was that the research questions were not clearly outlined. In addition, the research design lacked details about the procedures. The findings on the other hand were explained in details. A limitation to the study was that only eight people from 35 coaches who were selected actually participated in the research study; the results could not be generalized.

The study supports research, that coaching can be used in adult learning to create transformation. For example, in the research study, *Understanding relationship: Maximizing the effects of science coaching*, conducted by Anderson et al. (2014), the study indicates that there is growing empirical evidence that instructional coaching can help teachers to transfer their learning to classroom practice. This transfer of professional training such as new instructional strategies to the classroom should be encouraged through coaching which will promote greater collaboration and reflection amongst teachers (Anderson et al., 2014). This research study was longitudinal in nature and lasted over a period of five years; 15 schools in one urban school district in Northwest, United States were used. Five schools were elementary, five middle and
five high school; however, 10 remained as active participants until the end of the research study. The science coaches were selected from across the district and were assigned to one or two schools (Anderson et al., 2014). The sampling methods for the science coaches were not mentioned in the research. Data were collected through the use of both qualitative and quantitative data strands. The data sources that were used included: classroom observations, online coaching log entries, surveys, reflections, and interviews (Anderson et al., 2014). In addition, data analysis for the qualitative data was coded for themes and aligned to the research questions (Anderson et al., 2014). The findings of the research study indicate that there is a direct correlation between the coaching relationships and the productivity of the intervention. Anderson et al. (2014) elucidate that the findings will provide considerations related to organizational capacity, flexibility and adaptability of schools to facilitate the coaching model among teachers. While the study lasted for five years and gave enough time to examine the effects of coaching in the science classroom, the intervention was not clearly outlined. Another weakness that was identified was that, there was no evidence in the study how the sampling of the participating schools or science coaches was done.

*Developing an integrated framework of problem-based learning and coaching psychology for medical education: A participatory research* was conducted by Wang et al. (2016). The study examined medical schools that were making an effort to develop their own problem-based learning approaches based on their educational conditions, human resources, and existing curriculum structures. The purpose of the study was to explore a new framework by integrating essential features of problem-based learning and coaching that were applicable to undergraduate science students. The sample for the study was 14 people which consisted of four educational psychology researchers, eight undergraduate science students, and two accredited
PBL tutors. Data were collected using both qualitative and quantitative strands. Data sources included: semi-structured interviews, observation, group meetings, and workshop documents. Four workshops were held over a period of four months. The initial workshop was used to discuss the research framework and discussion on the PBL curriculum. The other workshops were used to blend the main features of coaching and PBL in the classroom (Wang et al., 2016).

Other concepts that were discussed in the workshops included, investigating the advantages and limitations of the models, strategies for advancing the model of PBL, and coaching psychology. In addition, final refining of the integrated model and practicing of essential coaching skills and practices were discussed (Wang et al, 2016). Quantitative data were collected from feedback surveys. While this research study was not framed by theory, coding for themes was done for the qualitative data. The themes that emerged from the data were: (a) current experience of PBL, (b) curriculum, (c) the roles and relationships between tutors and students, (d) student group dynamics, (e) development of self-directed learning, and (f) coaching in PBL facilitation (Wang et al., 2016).

The findings of the research study by Wang et al (2016) indicate that coaching psychology could be incorporated into the facilitated PBL system. In addition, the integration of PBL and coaching psychology in science and more directly medical education has the potential to promote the development of learning goals with the ability to nurture clinical reasoning ability, lifelong learning capacity and medical humanity (Wang et al, 2016). There are some weaknesses that were identified in the research study. There were no clearly written research questions, the research design even though participatory in nature did not plainly outline the actual intervention showing the implementation of the integrated model of PBL and coaching.
The only intervention that was described was the four workshops that were held (Wang et al., 2016).

Killion (2017) conducted a meta-analysis of 37 research studies of teacher coaching. The review indicates that there was a pooled effect of both general and content-specific coaching that was largely measured through qualitative data in the form of classroom observations. Killion (2017) elucidates that the effects of teacher coaching on students’ achievement was done mainly across reading, math, and science subjects. The effects on all three areas were positive and significant. However, on the other hand, content specific coaching was positive and significant for reading only, because the number of studies for math and science content was small. Only two research studies for math and science subjects were found. Hence the results are not significant due to the low total of four out of the 37 research study that were reviewed (Killion, 2017). Killion (2017) indicates that the review of meta-analysis of studies was guided by three research questions. The research questions were: (1) What is the causal effect of teacher coaching programs on classroom instruction and student achievement? (2) Are specific coaching design elements associated with large effects on reading achievement and (3) What are some of the implementation challenges and potential opportunities for scaling up high-quality programs in cost-effective ways?

Thirty one research studies used experimental design, 26 of these evaluated content-specific coaching (Killion, 2017). The meta-analysis of research study did not indicate if any of the studies that were reviewed utilized theory as a framework. Also, there was no mention of how theory guided the formation of the research questions, data collection or data analysis. Killion (2017) indicated that the results of the meta-analysis lack generalizability because of the small number of research studies that were analyzed. Killion (2017) explains that the review can
provide future researchers with a foundation for more rigorous study. The limited research of sustained professional development using coaching in science has strengthened the need for this teacher-researcher to examine the impact that coaching can have on teachers’ instructional practice.

The critical analysis of these empirical research studies has provided a guide to the researcher for future research in science education. Some areas that guided the research study include the use of transformative learning theory as the theoretical framework. In addition, qualitative data were coded for themes and compared with TLT constructs for final analysis. The procedures of the research were guided by TLT constructs; for example, in the action research cycle where critical reflection, dialogue, and individual experience (Mezirow, 2009), was dominant at this stage for all participants of the research. This was detailed in subsequent chapters in the research study.

**Research Questions**

1) How will professional development through the coaching model transfer to teachers’ instructional praxis?

2) Elements of PBL implementation will increase because of the intervention of the coaching model.

3) What are teachers’ perceptions about PBL implementation and the coaching model?

4) The research study improved the teacher-researcher’s research and praxis
CHAPTER III: METHODOLOGY

The purpose of this action research study was to implement professional development in science using coaching. This approach allowed the researcher to examine, if, through sustained professional development, teachers’ instructional practice could be transformed. Data from the needs assessment were used to create the professional development intervention for science and mathematics teachers. Problem-based learning teaching strategy was the instructional tool that was used with the teacher-participants for the enactment of the skills learned. This chapter discusses the processes that were undertaken for the research study. This includes the research design, research questions, and the professional development intervention that was framed by transformative learning theory. The chapter also discusses what sources were used for the collection of data at different stages of the research study and how data were analyzed. In addition, the sampling procedures, participants, timeframe of the research study and steps that were taken by the researcher to increase validity and credibility of the data collected will be discussed.

Research Questions

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Research Design

This action research study sought to examine the effects of the implementation of professional development in science using coaching and how this affected teachers’ instructional practice. During the intervention in the action research, problem-based learning strategies in science and math classrooms were used during Iterations 1 and 2. Coaching was utilized as the professional development strategy. “The purpose of an action research is for practitioners to investigate, inform and improve their practices” (Hendricks, 2013, p. 4). In the action research study, qualitative and quantitative data were collected for the needs assessment and in the action research cycle when the professional development intervention was enacted. An action research design is a formal process that includes purposive inquiry through identification of a problem, planning, and implementation of an intervention. In addition, it includes collecting data as evidence and interpreting results for addressing the phenomenon being studied (Bruce et al., 2011). This method of inquiry involves action that is done collaboratively, participatory, and through reflection at each stage of the cyclical process. In action research, practitioners will systematically look at ways to deal with issues that affect them; this is done in collaboration with colleagues (Hendricks, 2013). Participants in an action research are not selected randomly, but chosen from individuals who their daily practice revolves around the phenomenon that is being studied (Banegas, 2011; Hendricks, 2013). The goal was to utilize the expertise of all participants in order to answer the issue that has been identified (Hendricks, 2013).

As a science teacher and member of the leadership team at a charter school in Southern Connecticut, the aim of the researcher was to explore what are teachers’ perceptions and knowledge about professional development and their ability to transfer skills learned in professional development workshops to the classroom. In addition, the researcher aimed to
uncover the teachers’ perceptions about problem-based learning strategies and how these can be utilized in the classroom. Secondly, the researcher sought to confirm if sustained professional development through coaching would transform science and math teachers’ instructional practice. In the action research cycle, the researcher followed up with science teachers using different measures such as class observations, interviews, critical reflection and dialogue to assess the effectiveness of the implementation of professional development through coaching. Finally, the critical reflection that was done and science teachers’ feedback allowed the teacher-researcher to assess and improve her own praxis as a science teacher and a member of the leadership team at the school.

Hendricks (2013) elucidates that action research is a systematic and self-critical inquiry. It is systematic because a specific structure or set of steps is followed and the action research process which is cyclical in nature was utilized (Hendricks, 2013). The action research steps include planning, acting, observing, reflecting, and making adjustments; these are repeated in the iterative cycles (Hendricks, 2013; Kemmis & McTaggart, 2007). While action research is systematic, Dick (2002) explains that the process can be flexible and responsive. This means that the research design may have to be altered as the researcher learns more about the situations that are associated within the local setting/conditions (Dick, 2002). This was done and it allowed for improvements and adjustments at each iteration during the action research cycle while peer coaching was done and skills learned are transferred to the science and math classrooms.

The action research study that was conducted began with a needs assessment, as the researcher sought to answer research questions one and two. These questions sought to uncover the teachers’ perception about professional development at the school, what are their views about professional development for science teachers, and how will the professional development
workshops that are being done at the school guide the process of implementation in classes. In addition, the research study aimed to uncover teachers’ perceptions about problem-based learning (PBL), its uses, and if PBL could positively influence students’ learning in the classroom. In addition, the researcher sought to find out why this instructional strategy was not implemented after the problem-based learning workshop that was previously held at the school. The needs assessment was based on a constructivist paradigm, where the researcher collected and analyzed data sources from qualitative data strands. Data were collected from pre-interviews and the questions were semi-structured. In addition, direct classroom observations, secondary source data to include school charter, science curricula for four grade levels, and existing lesson plans from all grade levels were reviewed. These data sources assisted the researcher to uncover teachers’ perceptions, knowledge and needs about PBL implementation and other local conditions. In addition, teachers’ perception about the professional development that is received at the school indicated the need to assist in the enactment of PBL lessons. The data were analyzed with the knowledge from the literature review, an applicable problem-based learning professional development training workshop, and peer-coaching model that were implemented (Hendricks, 2013). The intervention iterations of the research study were used to assess if the professional development in science and math using coaching had transformed the participants instructional practice.

The action research cycle included three iterations. Action research is a cyclic process, which involves various iterations and reflections, which are done by the participants and researcher after each step within an iteration (Hendricks, 2013). The use of critical reflection was initially done by the researcher to identify the phenomenon that was being examined. In addition, critical reflection became important at the needs assessment stage of the research when teachers
participated in semi-structured interviews; at this point their views, perceptions and ideas were shared, recorded and transcribed. The researcher also reflected on the process to identify what other steps would follow the needs assessment stage. When critical reflection is done at each stage of the research, it will allow the participants to adjust the mistakes that are made and gives the teacher-researcher insights on how to enhance the process (Robbins, 2015).

Data analysis from Iteration 2 informed the researcher about changes to be made in Iteration 3. The third iteration ascertained if participants were able to select suitable science topics that could be used as lessons to teach in a sequential way that would provide scaffolding for students learning. In addition, to create problem-based learning lesson plans, implement PBL lessons in science over a period as well as allow the teacher-researcher to make modifications to the planned intervention. In addition, in Iteration 3, math teachers completed all activities that were done in Iterations 1 and 2 with the science teachers.

**Intervention**

Action research is an iterative process that includes the use of an intervention that is chosen based on local needs. For the intervention plan, measures are applicable to determine learning and scope on the part of teacher (Hendricks, 2013). In addition, the measures are carefully selected to capture these aspects and are modified as the intervention proceeds through the iterations. The researcher learns from each iteration with data analysis and reflection and makes adjustments where needed (Dick 2002; Hendricks, 2013). The action research stage included three iterations. In this research study, sustained professional development in the form of coaching for science and math teachers was used. The teacher-researcher served as a coach as participants collaborated, using experience, dialogue, and critical reflection to effectively
implement problem-based learning strategy in science and math classrooms (Mezirow, 2009; Robbins, 2015).

The researcher used the peer-coaching model throughout the professional development intervention process of the research study. The form of peer coaching that was used is formal coaching. Formal coaching usually follows training in specific skills that are learned and are implemented in instructional practice (Robbins, 2015). Robbins (2015) elucidates that if this is the main concentration of the coaching relationship, over a period, it will become routine and lack reflective practice. To ensure that this was minimized, and the coaching relation becomes effective and sustained, the researcher sought to identify if the main focus of the sustained professional development and the implementation of PBL strategies are elements that matter to the individuals that are involved (Robbins, 2015). This was uncovered in the needs assessment stage and the workshop training highlighted the benefits of problem-based learning in the science classroom. When formal coaching involves the teacher-participants’ interests it will increase reflective practice, teaching repertoire and resourcefulness. The ultimate goal is to increase students learning, which will be achieved when the teachers instructional practice is transformed (Robbins, 2015; Showers & Joyce, 1996).

The professional development intervention sought to answer research question, elements of PBL implementation will increase as a result of the intervention of the coaching model. The researcher used the weekly common planning time that is assigned at the school as well as teachers’ non-contact time after school to conduct training, meetings, plan lessons, and to do other key aspects that were conducted in the research study. The professional development intervention began with Iteration 1, and a focused group meeting with the science teachers and the teacher-researcher. At this meeting, the researcher discussed data that were analyzed from the
needs assessment. The teacher-participants were informed of the steps to be taken over the four months period and the timelines were discussed. The participants were made aware of the theory that would be used to guide the professional development intervention and the research study in general. The theory that guided the conceptual framework for the research is transformative learning theory that was developed by Mezirow. Although most of the research that incorporates transformative learning practices was done in higher education settings, recent research has shown that the theory is being used in other sectors such as human resource training and distance education (Mezirow, 2009). Taylor and Cranton (2012) agree that the theory has been used in many other sectors than higher education, but more so, transformative learning theory has evolved over the years in relations to its philosophical underpinnings. Also, learning is now seen as change both personally and politically. In addition, learning appreciates the role of context, other ways of knowing, and how it shapes the process of transformation (Taylor & Cranton, 2012). Participants were also informed about the professional development approach that was taken and the activities that were involved in the coaching model.

Professional development training in problem-based learning was conducted by the teacher-researcher using the traditional approach of workshop sessions. During the training, participants were taught about problem-based learning theory, problem-based learning strategies and benefits of using this teaching strategy in science as indicated by different researchers. Teachers were exposed to problem-based learning required competencies and best practice elements. In addition, the researcher conducted awareness sessions about per-coaching and discussion was done using Robbins (2015) model to explain what should be expected during the coaching model. The researcher sat with individual science teachers to identify and select appropriate topics using the curricula from Grades 7-10 to co-plan each lesson using the PBL
lesson plan template (see Appendix A). Lessons were planned in alignment with the use of Connecticut Common Core State Standards (CCSS) and the Next Generation Science Standards (NGSS) expectations. The teacher- researcher modelled the implementation and facilitation of a PBL lesson using the peer-coaching model, which served as a guide for the teacher-participants. In addition, different teaching resources were developed; engaging activities that incorporated the key constructs for PBL were planned, and other resources identified. In addition, assessments and enrichment activities were selected through collaboration and dialogue between the teacher-participants and the researcher. Data from the intervention were collected through teacher-participants reflections and the researcher’s journal notes.

During Iteration 2, science teachers, through guidance and collaboration of the teacher-researcher, implemented PBL lessons in each grade level using the lesson plans that were created. During the enactment stage, as science teachers implemented lessons, the researcher conducted class observations for four classes, one per grade level. In addition, the researcher conducted daily updates and weekly meetings to assess if the PBL strategy was implemented as modeled or if any adjustments should be made. The class observations were done using the PBL checklist and data collected using field notes/memos. The teacher-participants completed personal journals per grade level through critical reflection for each iteration. In addition, the researcher completed field notes/memos, and critical reflections for each iteration activities. Dialogue, which is a key construct of transformative learning theory, was done with science teachers using formal and informal meetings to assess their feedback from the implement of PBL lessons. The teacher-researcher did field notes to capture all dialogue with participants. Qualitative and quantitative data from Iteration 2 were analyzed and were used to inform the activities for Iteration 3.
Iteration 3 began with a meeting with one science teacher whose lesson for Grade 9 was completed before the other classes and grade levels. Using different data strands, information that was collected and analyzed in Iteration 2 were discussed. However, the reflection of the teacher-participant also guided what was planned for Iteration 3. When all science teachers completed Iteration 2, data were shared and the teachers’ and researchers’ reflections guided the adjustments for Iteration 3. Planning was done at this stage to reflect on areas for adjustments and enhancement; this was done in a focus group meeting. Teacher-participants and the researcher selected suitable science topics from all grade levels and PBL lessons were planned and implemented. Lesson plans were done using the state standards as indicated in Iteration 2. The researcher completed peer observation in science classes using the PBL checklist. This helped to assess if the science teachers were feeling more comfortable to effectively implement PBL in classes. The researcher used field notes and observation data analysis to guide the next focus group and individual meetings. This allowed for adjustments that were made.

In Iteration 3, teachers of mathematics at the school who have classes between Grades 7 to 10 (N=2) implemented problem-based learning strategies in their classes. In addition, science teachers repeated the process that was done in Iteration 2. The teacher-researcher completed the steps that were done in Iteration 2 for the science teachers where teachers were trained and co-planning was done individually with the math teachers. The math teachers collaborated with the researcher as training materials, planning strategies, and enactment package were used by the teacher-researcher and science team PBL or implementation. Coaching through modelling and development of resources was done for math teachers before enactment of lessons. Class visits will also be done and data collected using the PBL checklists. All teachers of math and science in this iteration (N=4) completed reflection journal entries to record their reflection of the classes,
meeting and the coaching process. The teacher-researcher shared observation and data analysis after the period of enactment was completed.

According to Dick (2002), action is followed by critical reflection to look at what worked and what did not work. In addition, what have been learned by the teacher-researcher and the teacher-participant and how could things be done different the next time. These areas were considered as the researcher and participating teachers sought answers to the research question. Towards the end of the Iteration 3, a post semi-structured interview was done with the participants using a group meeting to ascertain their feedback about the professional development that was done through formal peer coaching. In addition, at end of Iteration 3, data analysis was done and shared with participants. All teachers were encouraged to do another iteration on their own, and this would help them to become more comfortable with implementation of PBL lessons in their classrooms.

Table 1

Research Design

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Procedural Design</th>
<th>Data Collection</th>
<th>Data sources</th>
</tr>
</thead>
</table>
| 1) What are teachers’ perceptions about PBL implementation and the coaching model? | Needs Assessment | Qualitative Data | Teachers’ interview that will be semi-structured in nature (N=4; math and science)  
Participant selection through convenience and purposeful sampling | |
| 2) PD through the coaching model transfers to teachers’ instructional praxis. | Action Research  
**Iteration 1**  
a) Review and discussion of data findings from needs assessment. | Qualitative | Meeting Notes (taped and transcribed), Field Notes and researcher’s reflection | |

(continued)
### Qualitative Data Collection

**Research Questions**

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Procedural Design</th>
<th>Data Collection</th>
<th>Data sources</th>
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</thead>
<tbody>
<tr>
<td>3) Elements of PBL implementation will increase as a result of the intervention of the coaching model.</td>
<td>b) Focus Group meeting – explaining the steps to be taken for the research study and timelines.</td>
<td>Qualitative</td>
<td>Transcripts from audio for training and planning sessions, field notes, teachers’ reflection journals and teacher-researcher reflection.</td>
</tr>
<tr>
<td>4) The research study improved the teacher-researcher’s research and praxis?</td>
<td>c) <strong>Intervention (PD):</strong> Training of teachers in PBL strategies. What is coaching, what will be involved in the peer-coaching model, co-planning of PBL lessons for science classes (4 grade levels).</td>
<td>Qualitative</td>
<td>Meeting notes and transcript Participants journal reflection Field notes/memos and Researcher’s reflection of researcher at each stage during the process. Teacher-participants reflections for classes/PBL cycle. Meeting notes and transcript from audio recording.</td>
</tr>
<tr>
<td></td>
<td>d) Modelling by teacher-researcher of sample lesson, co-creation of classroom resources.</td>
<td>Qualitative</td>
<td><strong>PBL Instruments</strong> PBL checklist with memo <strong>Lesson Plan review:</strong> PBL lesson Plan template</td>
</tr>
<tr>
<td></td>
<td><strong>Iteration 2</strong> e) Implementation of PBL lessons by science teachers in four grade levels, coaching of teachers through the process</td>
<td>Quantitative</td>
<td>Qualitative</td>
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<td></td>
<td>f) Reflection of science teachers and researcher’s notes</td>
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<td></td>
<td>g) Dialogue – Focus group and individual meetings</td>
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<td>h) PBL checklist for classroom visit</td>
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<td></td>
<td><strong>Iteration 3</strong> Science and Math a) Review and discussion of data findings from Iteration 2</td>
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<td></td>
<td>b) Science teachers will plan PBL lessons for each grade on their own using knowledge from Iteration 2</td>
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Procedural Design

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Procedural Design</th>
<th>Data Collection</th>
<th>Data sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>c) Enactment of PBL lessons planned by teacher-participants.</td>
<td>Direct observations – Math teachers planning meeting</td>
<td></td>
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<tr>
<td>d) Math teachers go through the process of Iterations 1 and 2 for science teachers that were implemented.</td>
<td>Audio recordings for Math and science teachers focus group meetings /meeting notes</td>
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<tr>
<td>e) Co-planning and implementation of PBL math lessons by Math teachers.</td>
<td>PBL Behavioral checklist</td>
<td></td>
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<tr>
<td>f) Reflection</td>
<td>Reflection: Journal entries for math and science teachers for PBL cycle for each grade.</td>
<td></td>
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<tr>
<td>g) Dialogue</td>
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**Procedures**

**Role of Researcher**

As researchers seek to become involved in a process of inquiry, it involves philosophical assumptions, beliefs as well as the distinct methods, and methodologies that may shape how the research study is done (Creswell, 2014). *Worldview* is a term used in research to indicate a basic set of beliefs that guides the actions of the research study. It is also referred to by numerous researchers using the term, *paradigm* (Creswell, 2014). The investigator in a research is guided, not only in choices of method but in axiological, ontological, and epistemological ways (Guba & Lincoln, 1994). Researchers bring to the research study, assumptions which include their knowledge (epistemology), nature of reality (ontology), values of the researcher (axiology), and inductive or deductive approaches which are shaped by the researcher’s experience in collecting and analyzing data (methodology) (Christ, 2013; Creswell, 2009; 2014; Teddlie & Tashakkori, 2009). According to Christ (2013), the researcher should avoid a philosophical stance that is rigid, which may confine the views to a particular paradigm or choice of method to be used during the research study.
In this research study, the researcher took a pragmatic stance in relation to the epistemology, axiology, and methodological approaches (see Appendix B). Pragmatism draws on many ideas that include what will work, using different approaches, and valuing both subjective and objective knowledge about the phenomenon that will be examined (Creswell & Plano Clark, 2011). Pragmatism embraces the notion of using multiple data sources for data collection to inform the problem that is being studied (Beista, 2010; Creswell, 2009; 2014; Creswell & Plano Clarke, 2011). During this research study, qualitative and quantitative data were collected using different sources such as filed notes/memos, PBL checklist, journal entries and review of secondary sources. However, in the needs assessment stage the researcher took on a constructivist paradigm. A constructivist researcher normally addresses the procedures of interaction among individuals. In addition, these researchers concentrate on the specific contexts in which people live and work, in an effort to understand the cultural and historical settings of the participants (Creswell, 2012). The main goal of a researcher is to depend on the participants’ willingness to share their views of the phenomenon that is being studied.

In the needs assessment stage, the researcher took an emic role. That is, the teacher-researcher and the participants co-constructed meaning from the qualitative data that was collected. Taking an emic role, the teacher-researcher co-constructed meaning from the semi-structured interviews, focus group meeting notes. In addition, the researcher’ field notes/memos and teacher-participants’ reflection notes were used as data sources in the co-construction process with the teacher-participants. The researcher took on an exploratory role when examining the participants’ perceptions about coaching as a professional development initiative at the school and in science and math classes. In addition, the participants’ perceptions about the use of problem-based learning strategies in science and math classes were examined. As a
member of the science department and a colleague of the science teachers, an insider’s perspective was evident because of the relationships that have been established. This helped the researcher to solicit honest and open responses to the interview questions that were asked.

The action research stage, which included the professional development intervention, the researcher took an emic and etic stance. As an insider (emic role) and colleague of the participants, the researcher acknowledged any form of bias that may influence the data interpretation and maintained an etic stance at this stage of the research process. The researcher took on an etic role when quantitative data were collected. Quantitative data source that was utilized was the PBL behavioral checklist that was used during the classroom observations for Iterations 2 and 3. An emic stance was taken when the researcher and teacher-participants co-constructed meaning from the qualitative data that was collected. These included post semi-structured interviews, focus group/individual meeting notes, field notes/memos, researcher’s reflection notes, participants’ reflections and transcripts from audio recordings. Semi-structured interviews with teachers were done towards the end of Iteration 3; this assisted in final data analysis for examining if teachers’ instructional practice was transformed.

An important aspect of any research study is the experience, knowledge, and background of the researcher. As a current science teacher, former administrator in education and presently a member of an educational leadership team at the school, the researcher’s experiences, knowledge and skills have shaped her beliefs and motivation for this research study. The researcher gained insights about the professional development initiatives that have been done at the school and the organization’s group of schools. It is from this viewpoint as a science teacher, as well as a member of the leadership team that the researcher was influenced by a pragmatic worldview in a
quest to understand and integrate a system of improved professional development initiative that will transform instructional practice.

Bounding the Case

The focus of this action research study was to examine the effects of implementing professional development in science using coaching. During the implementation of sustained professional development, problem-based learning was used as the instructional strategy in the science classroom; this helped to measure if the teachers’ practices are transformed. This was done: (a) by ascertaining the teachers’ perceptions about implementing professional development using coaching, (b) by uncovering teachers’ perceptions about the use of problem-based strategies in science, and (c) by using transformative learning theory framework to guide the implementation of the professional development intervention. The research study was conducted at one charter school in southern, Connecticut, United States. This school was chosen using convenience sampling (Patton, 2015) because of its accessibility for the researcher.

The total population of the charter school is 610 students; 200 of this total pursue a science subject at Grades 7 to 10. The teacher-participants for the research study were two science and two math teachers \((N=4)\) who were assigned to the four grade levels (Grades 7-10). The researcher interacted and collaborated with the participants during the professional development session, planning of PBL lessons and enactment through the coaching relationship. The science teachers taught different science subjects such as life science, earth science, physical science and biology. Nine groups were taught in the four grade levels, but this research study focused on four groups, one from each grade level. In addition, the math teachers that implemented PBL strategies in Iteration 3 are teachers of geometry and advanced math. The research study lasted from fall 2019 to spring 2020 this began from November through to March;
which will be a period of 4 months. This allowed time for the needs assessment, where the data were collected and analyzed. In addition, planning and implementation of the professional development intervention that was done with the participants. During the intervention stage, reflection, refining and re-planning at each iteration and analysis of data was done (Charmaz, 2014; Hendricks, 2013).

**Sampling**

The sampling design should be carefully planned and implemented because the process has a significant impact on the quality of the research findings and implications for the validity and credibility of the research study. According to Teddlie and Tashakkori (2009), sampling is the process where units of analysis are selected; it provides the opportunity for the research questions to be answered. In addition, sampling designs represent a framework which involves the number or types of sampling schemes, strategies and sample size to be utilized for selection of a subset from a population (Collins, 2010; Onwueguzie et al., 2007; Onwueguzie & Leech, 2007; Szafran, 2012; Teddlie & Tashakkori, 2009).

Sampling procedures can be classified into four broad categories, namely: probability, purposive, convenience, and mixed methods (Teddlie & Tashakkori, 2009). This research study utilized purposive and convenient sampling techniques. Purposive sampling is the process of selecting units based on specific purposes associated with answering the research questions in the study (Collins, 2010; Teddlie & Tashakkori, 2009). Purposive sampling schemes are usually used in qualitative research and this includes purposeful selection of a small number of participants by the researcher. In the research study that was conducted, the participants were selected using purposive sampling because they are the science teachers at the selected school. The main aim of doing this was to gain insights from different perspectives about the effects of
professional development implementation in science classrooms and the implications for teachers practice (Collins, 2010).

**Data Collection**

For the research study, data were collected using quantitative and qualitative sources. In the needs assessment stage, qualitative and quantitative data were collected, while both data strands were used to collect information during the action research cycle.

**Semi-Structured Interview**

The researcher conducted two sets of semi-structured interview which included one pre-interview that was semi-structured in nature (see Appendix C and Appendix D). Semi-structured interviews were conducted in the needs assessment stage as the researcher sought to answer the relevant research questions. The researcher sought to uncover the teachers’ perceptions about professional development that is done at the school and their ability to transfer the skills to the classroom after a workshop is done. In addition, the researcher sought to examine what were their perceptions about coaching and problem-based learning strategies to be used in the classroom. Semi-structured interviews were also conducted at the end of Iteration 3 in March 2020. The interview questions sought to collect data on the science and math teachers’ experience, beliefs, knowledge, and feedback of outcomes after the implementation of the peer-coaching. In addition, their beliefs and experience about problem-based learning strategy in science/math classrooms and if the intervention made any impact in transforming their instructional practice. The post-interview was conducted in a meeting setting with the participants, this was audio recorded and transcribed for data analysis. When the interview was conducted in a group, this ensured that the teacher-participants are asked the same questions in the same sequence (Patton, 2015). The researcher was able to probe for deeper meaning and
understanding at the same time with all participants, which increases the validity of the research (Patton, 2015).

**Secondary Source Data**

The researcher collected secondary data using multiple artifacts. Data were collected from the school’s charter/policy document, which outlined the expectations for instructional staff and students. In addition, science and math teachers’ existing lessons plans, science/math curricula were reviewed. The review included one curriculum for each grade level for Grades 7 to 10 in science and math for Grades 7 and 8. These were coded and reviewed using a data matrix (see Appendix E) that was used to organize data that were collected using the emergent themes. A data matrix allowed the researcher to develop and show, the connections between specific parts/document relating to the research question (Maxwell, 2013). In addition, the researcher used memo to capture additional data throughout this process. Critical reflection was done by the researcher upon completion of the data collection and review of the secondary sources. This information was used to guide the planning of the action research cycle (Mertler, 2005; Hendrick, 2013).

**Focus Group and Individual Meeting Notes**

Focus group and individual meeting notes were captured at the needs assessment stage and in all iterations in the action research cycle of the research study. Focus group meetings were held at the beginning and end of Iterations 2 and 3 at the assigned common planning time that is scheduled by the school. In addition, weekly meetings were held with teacher- participants and updates and adjustments to plans and scheduled were discussed. Transcripts were written from the audio recordings from meetings to capture qualitative data. In addition, the researcher’s field notes captured data that were used in the research study.
**Researcher's Field Notes and Reflection**

Field notes/memos were done by the researcher to collect data that were captured at individual meetings and for group settings as participants are observed and dialogue takes place. Formal and informal meetings that were held by the researcher also captured observations noted in relation to the research study. The researcher ended major activity with field note/memos and with reflection entries. In addition, the participants’ reflection journal entry for each cycle per grade level provided data for the research study; this informed the process. For ethical reasons, reflection journal entries for each participant were kept confidential between the researcher and the individual teacher-participant.

**Field Notes/Memos**

Direct observation was done in science at each grade level as well as math classes. The decision to complete classroom observation with the math teachers at this stage was adjusted because of the data that was collected in the needs assessment. This observation sought to capture what instructional practices existed in the classroom, students’ activities, responses of students to the lessons that were being taught and the teachers’ interaction with the students. The aim was to assess how learning was facilitated and what aspects would address during the intervention and coaching process. This also gave a baseline for data comparison after training was done and the coaching model was being applied. PBL observation field notes were collected during the action research cycle for Iterations 2 and 3. The data also captured the students’ activities, the researcher’s observation if the PBL competencies and elements were evident during the lessons that were taught and the teachers’ interaction with students while promoting learning. In Iteration 2, four science classes were observed; one at each grade level. In Iteration
3, four science classes and two math classes between Grades 7 to 10 were observed. The researcher observed one class that is taught by each math teacher.

**PBL Lesson Plans**

Data for lesson plans for each grade level (Grades 7-10) were collected at Iterations 2 and 3. This included reviews using the problem-based learning lesson plan template to assess if lessons included the appropriate tenets and implemented as planned. In addition, the PBL checklist was used for review of the lesson taught. The researcher also wrote memo to capture if the lesson plans were written to incorporate the key tenets of problem-based learning.

**PBL Observation Behavioral Checklist**

The PBL observation checklist was quantitative in nature and was used for all classroom visits for the needs assessment, Iterations 2 and 3 (see Appendix F). The PBL observation checklist sought to observe if measurable best practices/elements with the main PBL tenets can be observed in the science classroom for Iteration 2 and for math and science classes in Iteration 3 (see Appendix G and Appendix H). Data were collected through closed responses by an indication of a check symbol if the measurable practices were evident during the class visits. The researcher also did memo writing to capture other observations during the visit.

**Data Analysis**

**Secondary Sources**

In a qualitative research, a description is a detailed explanation of people, events, and places in a particular setting (Creswell, 2012). During the needs assessment, secondary data were collected, these were analyzed using descriptive codes to determine if the science teachers’ lesson plans are aligned to curricula, do they have elements of problem-based learning strategies, are there suggested instructional strategies and are they used by teachers. The researcher
reviewed to see if there were correlations between curricula, lesson plans, class visits and professional development workshops that were done at the school. The school’s charter was also examined and data gathered using codes. Data analysis of these documents was compared with the data of the direct observations from class visits that gave deeper understanding of teachers’ perceptions of professional development for science teachers.

**PBL Observation Behavioral Checklist**

Data from this instrument were analyzed using numeric values and statistical description for the needs assessment, Iterations 2 and 3. This data provided feedback and an overall representation of PBL measures and best practices/elements that were employed in the science and math classes. Coaching strategies were modified after the data analysis in Iteration 2. This was slightly done for the science teachers upon analysis, there was the need for further adjustments and enrichment of the lesson plan, classroom activities, and the teachers’ approach or interactions in the classroom. Data from Iterations 1, 2, and 3 provided adequate data comparison to be used in the data merging process. Analytical notes from the researcher’s memo and reflections were coded using initial, focused and axial processes. Emergent themes were then discussed. The researcher also coded the document to identify themes relating to the teachers’ professional development to identify if the main elements of transformative learning could be seen during the process. The researcher was in constant dialogue with the teachers to share the findings throughout the process and do member check. In addition, teacher- participants and the researcher completed reflection journals after each iteration/PBL cycle.

**Field Notes/Memos**

Qualitative data were initially coded for themes that emerge in the data. The researcher then coded for common themes for the observations that were done at the grade levels. Further
thematic coding was done emergent theme form the qualitative sources in Iterations 2 and 3. A comparison chart was used to identify what sources and the relevant themes that were coded; this side-by-side chart gave the researcher a through view of themes that emerged from the data. The teachers and classrooms were given pseudonym names/numbers to maintain confidentiality (see Appendix I, Appendix J, and Appendix K). The comparison chart will provide a visual representation for the researcher to assess data and do critical reflection that informed Iteration 3 and for future researchers. Through dialogue, the teachers were informed about the data analysis from Iteration 2 and this served as a guide for adjustments for Iteration 3.

**Field Notes from Meetings and Reflections**

Participants completed reflections for each grade level for Iterations 2 and 3. In addition, field notes were done for each formal and informal meetings with the participants. All field notes, meeting notes, transcripts and reflections were initially coded individually. Further coding for themes were done as the researcher sought to identify emerging themes and themes that could be identified with the PBL or TLT constructs. Comparison chart and triangulation of data was done using meeting notes, the researcher’s field notes and participants and researcher’s reflections. Data analysis was done after each iteration. Data from Iteration 1 informed adjustments that were made in Iteration 3.

**Semi-structured interviews: Pre-and post-interviews**

Data were collected from semi-structured interviews that were done in the need assessment; due to scheduling and time constraints, these were done individually with the teachers of math and science (N=4). At the end of Iteration 3 the post- interviews were conducted in a group setting. Initial coding was first done for each transcript that was done in the pre-interviews The researcher then code for common themes that have emerged from the data of the
four interviews from the science and math teachers (N=4; see Appendix G). The researcher compared the emerging themes with the main constructs for transformative learning theory: individual experience, dialogue, reflection and context to see what have emerged. In addition, the researcher coded the field notes/memos, researcher’s and teacher reflections to see emerging themes and compared them to identify emergent themes.

Table 2

*Data Analysis*

<table>
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<th>Procedural Design</th>
<th>Data Sources</th>
<th>Data Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) What are teachers’ perceptions about PBL implementation and the coaching model?</td>
<td>Needs Assessment</td>
<td>Teachers’ interview were done are semi-structured in nature (N=4; math and science) Direct observation of 6 classes 1 per grade level and 1 for each math teacher Researcher’s Field notes/memos and researcher’s reflection, Review of secondary sources: Review of existing lesson plans (Grades 7 to 10) Curricula for all science subjects for Grades 7 – 10, curricula for math Grades 7 and 8, School Charter Lesson Plan review: Quantitative PBL checklist</td>
<td>Transcription of interviews Initial, focused and axial coding of each script Common thematic coding that emerged from all interviews Thematic coding for reflections and field notes. Descriptive Coding and use of comparison chart for lesson plans, curricula and charter document</td>
</tr>
<tr>
<td>2) PD through the coaching model transfers to teachers’ instructional praxis.</td>
<td>Action Research Iteration 1</td>
<td>Meeting notes (taped and transcribed). Field Notes and researcher’s reflection Transcripts from audio for training sessions, field notes, teachers’ and teacher- researcher’s reflections PBL Instruments PBL Behavioral checklist with researcher’s memo Meeting notes and transcript Participants reflections Field notes and reflection of researcher at each major stage during the iterations. Teacher -participants – reflections for classes and meetings.</td>
<td>Initial, focused and axial coding were done, Emergent themes from data Additional codes relating to TLT and PBL Thematic codes that emerge from data. Thematic code comparison according to TLT and PBL Thematic coding for PBL constructs</td>
</tr>
<tr>
<td>3) Elements of PBL implementation will increase as a result of the intervention of the coaching model.</td>
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<tr>
<td>4) The research study improved the teacher-researcher’s research and praxis?</td>
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<td>Research Questions</td>
<td>Procedural Design</td>
<td>Data Sources</td>
<td>Data Analysis</td>
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<td><strong>Iteration 2</strong></td>
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<tr>
<td>d) Implementation</td>
<td>Meeting notes and transcript from audio recording.</td>
<td>Thematic code</td>
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<td>PBL lesson by science teachers</td>
<td>PBL lesson plans using PBL lesson plan template, field notes for science classes.</td>
<td>Initial coding</td>
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<tr>
<td>e) Reflection of science teachers and researcher</td>
<td>Science teachers – reflection for iterations</td>
<td>Emerging thematic codes from the data</td>
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<td>f) Dialogue – group and individual meetings</td>
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<tr>
<td><strong>Iteration 3</strong></td>
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<tr>
<td>a) Review and discussion of data findings from Iteration 2</td>
<td>PBL Behavioral Observation Checklist</td>
<td>Descriptive analysis</td>
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</tr>
<tr>
<td>b) Science teachers will plan PBL lessons for each grade on their own using knowledge from Iteration 1.</td>
<td>Training and planning lessons – Math teachers</td>
<td>Thematic codes according to PBL construct</td>
<td></td>
</tr>
<tr>
<td>c) Enactment of PBL lessons planned by teacher- participants.</td>
<td>Audio recordings for Math teachers meetings / meeting notes</td>
<td>Initial codes from observation of math and science teachers’ meeting.</td>
<td></td>
</tr>
<tr>
<td>d) Math teachers will enact PBL lessons planned and modeled with teacher- researcher in their classes</td>
<td>Reflection: Journal entries for math and science teachers for Iteration 3.</td>
<td>Main thematic codes that emerge from data.</td>
<td></td>
</tr>
<tr>
<td>e) Planning and implementation of PBL math lessons by Math teachers.</td>
<td>PBL Behavioral Observation checklist – Math and science classes</td>
<td>Initial, focused and axial coding</td>
<td></td>
</tr>
<tr>
<td>f) Reflection</td>
<td>Teacher- participants reflection, field notes/ memo and researcher’s reflection journal</td>
<td>Descriptive analysis from PBL checklist</td>
<td></td>
</tr>
<tr>
<td>g) Dialogue</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Data Merging**

According to Creswell and Plano Clark (2011), “mixing during data analysis occurs when the quantitative and qualitative strands are mixed during the stage of the research process when the researcher is analyzing the two sets of data” (p. 67). Data merging happened during the process of data analysis at the needs assessment and action research cycle; the research cycle included both iterations. The qualitative and quantitative results that were collected and analyzed were arranged in a comparative chart in the form of a table. This permitted easy access for review, comparison and interpretation of both types of data (Creswell & Plano Clark, 2011; see Appendix G).
Inferences were drawn from the needs assessment and the two iterations during the action research cycle. The needs assessment stage had seven main data points. These included semi-structured interview, class observation observations (one per grade levels), and researcher’s reflection and field notes/memos. Secondary data (lesson plans, curricula and school charter document) were utilized for the comparison of emergent codes across qualitative data sources. This comparison matrix (see Appendix G) was used to provide a visual representation. The direct observation notes, meeting notes and semi-structured interviews were combined using the main themes and constructs for transformative learning theory. Member check was done as science and math teachers reviewed the data to ensure that their perceptions and thoughts were accurately represented.

During the action research cycle, six data points were utilized, these included PBL observation checklists from the class visits, field notes/memos that were kept at each step of the process. In addition, reflections were done by the teacher-participants after each iteration and reflections were completed by the researcher. Transcription from group and individual meetings were also collected and analyzed. The researcher compared data from pre-observational visits to classes with those done during and at the end of the iterations. The semi-structured interview data that was done before the professional development intervention during the needs assessment stage was compared and triangulated with the data that was collected from the post semi-structured interview at the end of Iteration 3.

**Credibility, Reliability, and Validity**

The research study used both qualitative and quantitative data strands; as a result, the researcher must establish quantitative validity and reliability, and qualitative credibility and trustworthiness (Tashakkori & Teddlie, 2009).
Quantitative validity is the quality of the numeric scores from the PBL observation checklists that was utilized during the research study and the quality of the conclusions that were drawn from the results of the analyses. In addition, quantitative data were retrieved from Marzano lesson plan rubric as the researcher assessed the lesson planning process and the implementation. No matter how good the research design might be, the results will be meaningless if the researcher is not measuring what is purported to measure (Creswell & Plano Clark, 2011; Mertler, 2014; Muijs, 2004). Internal validity in quantitative research refers to the accuracy of inferences drawn about the cause-and-effect relationship between variables in a particular study (Creswell, 2015). Quantitative researchers can strengthen the overall finding of their studies by specifically addressing common threats to internal validity (Teddlie & Tashakkori, 2009).

“Qualitative validity means that the researcher checks for the accuracy of the findings by employing certain procedures” (Creswell, 2009, p. 190). Validity depends on the relationship of the researcher’s conclusions to reality and this can be done through the use of various strategies to include, member-checking, triangulation, rich thick data, and asking other professionals in the field to examine the data (peer review) (Creswell 2014; Creswell & Plano Clark, 2011; Maxwell, 2013). In a qualitative research study, researchers are concerned about the validity of their findings. This is termed as trustworthiness, authenticity, and credibility of the data to be reported as it indicates the strength of the research study. Credibility involves establishing that the results of the research are believable, and credible from the viewpoint of the participants (Creswell, 2014; Mertler, 2014). Mertler (2014) explicates that trustworthiness deals with the accuracy and believability of the data which is established by inspecting the credibility and dependability of the data that is collected.
Credibility and trustworthiness of the data can also be secured by triangulation, which means multiple data sources and data-collection methods are used (Mertens & Hesse-Biber, 2012; Mertler, 2014). In this research study, multiple data sources were used that includes: semi-structured interviews, secondary sources, direct observation, field notes, meeting notes that were transcribed from audio recordings, and reflections. Qualitative data were gathered from teachers through semi-structured interviews. Two semi-structured interviews were done; one was administered in the need assessment stage and the other at the end of action research, Iteration 2. In addition, qualitative data were collected from secondary sources that included existing lesson plans that were used in the needs assessment stage. In addition, data were collected from science curricula for all grade levels (7 to 10), curricula for math for Grades 7 and 8, school charter, and participants’ reflections, researcher’s field notes/memos and teacher-researcher’s reflections. These provided thick rich data. The researcher ensured that the quality of the data is good by conducting member check. Member check is the process when the researcher shares interview transcripts, journal transcripts and meeting notes with participants with the aim of verifying that the information is represented correctly (Mertler, 2014).

Qualitative and quantitative data were triangulated to extract deeper meaning to the phenomenon being examined and for verification. “Triangulation involves using different methods as a check on one another to identify if the methods have different strengths and limitations that support a single conclusion” (Maxwell, 2013, p. 102). The researcher also was involved in prolonged engagement, peer debriefing and persistent observation; these are believed, to increase credibility and trustworthiness (Teddlie & Tashakkori, 2009). In addition, reflective journal is relevant to credibility, dependability and confirmability of the phenomenon under study (Teddlie & Tashakkori, 2009). This is so, because it is believed that the more time
spent in the field, there will be greater development of trust and getting to know the participants (Mertler, 2014). The research study lasted for four months with the hope that trust would be developed through the sustained professional development through the coaching relationship with the participants. This was evident as the different stages of the research study progressed.
CHAPTER IV: RESULTS

This research study was an action research that utilized a mixed method approach where qualitative and quantitative data were used throughout the process. The research study allowed the researcher to employ both approaches in the types of questions, methods, data collection, data analysis, procedures, and the inferences that were drawn (Tashakkori & Teddlie, 2009). The main purpose of this action research study was to examine the effects of professional development in science when coaching is used. In addition, another purpose was to investigate if this approach to professional development could potentially lead to the transformation of teachers’ instructional practice. During this research study, the instructional strategy that was used for professional development intervention is problem-based learning. Problem-based learning is a student-centered strategy that begins by using real life problems with small groups working to solve a problem that is posed (Davy, 2017; Delisle, 1997; Servant-Miklos, 2016).

One of the secondary source, the charter/policy document that was reviewed indicated that activities that were done in classrooms are student-led and students’ individual learning plans are done which promote students success and engage students based on their unique strengths. In addition, the Connecticut Common Core of Teaching Rubric for Effective Teaching (2017) encourages active learning which promotes student engagement. When class observations were done, the lessons were teacher-led and the classroom was not student-centered as indicated by the charter.

To examine if professional development through coaching could lead to the enactment of problem-based learning in class and hence transform teachers’ practice qualitative and quantitative data were collected and analyzed. The research study utilized semi-structured interviews to capture the perspectives of teachers in science and math in relations to the
implementation of coaching and PBL in classes. In addition, direct observations of classes, use
of secondary sources, teacher reflections and data from planning and coaching sessions were
used to support the results of this study. The research questions that framed the study are:

**Research Questions**

1) How does professional development through the coaching model transfers to teachers’
   instructional praxis.

2) Elements of PBL implementation will increase because of the intervention of the
   coaching model.

3) What are teachers’ perceptions about PBL implementation and the coaching model?

4) The research study improved the teacher-researcher’s research and praxis

The chapter presents the results for each stage of the research study that include the needs
assessment and action research cycle. For each stage during the process, the results are
discussed according to the qualitative and quantitative data strands. In addition, the dominant
themes from the qualitative data such as pre- and post-interviews, field notes/memos, teacher-
participants reflections, secondary sources and the researcher’s reflections are presented. Initial,
focused, and axial coding procedures were utilized in the analysis of both interviews (pre and
post), field notes/memos that were created from class observations and meetings, reflections
from teacher-participants and researcher. In addition, this process for coding was also employed
for the review of secondary source data. The researcher depended on constant review of frequent
initial codes that were sorted, synthesized, integrated and organized in large amounts of data so
that predominant themes could be identified (Charmaz, 2006). These were later compared to the
theoretical constructs for problem-based learning and transformative learning theories.
The Needs Assessment

Quantitative Results

Quantitative data were garnered from the PBL classroom observation checklist (see Appendix F). The researcher examined what was happening in the classroom in relation to PBL and the implications that this might have had for the lack of implementation of teaching strategies after professional development workshops are held. In addition, the quantitative data indicated to the researcher the steps that should be taken in the action research. Also, the data showed correlation of the data when compared with qualitative data that were collected and analyzed. The PBL checklist that was used for the classroom observations sought to capture required competencies such as pedagogical beliefs, technology use for higher-order thinking, classroom management skills, collaboration, and professional development (see Appendix F). Table 3 indicates six main competencies that are outlined on the PBL checklist and what was evident in the participants’ classes; also, how this relates to the research study that was conducted. The six competencies that were measured include pedagogical beliefs, technology use for higher-order thinking, planning and organization, classroom management skills, collaboration and professional development.

Pedagogical beliefs competency sought to capture if the lesson was student-centered and promote student cooperation and teamwork. This category also includes how students were encouraged to bring their own solution through inquiry and exploration in the classroom. For this competency, most teachers did not encourage student-centered learning in the classroom. This proved opposite to what the school policy indicates. In addition, during the observation, classroom management skills as outlined on the PBL protocol examined nine elements (see Appendix F). These include specifying group participation points, providing clear guidelines to
students, provide practical for example, providing alternate solutions to questions and problems and challenging students’ data assumptions and sources. Six of the nine indicators were non-existent in the classes that were observed.

Another key competency that was outlined on the PBL checklist was collaboration. All teachers indicated that they had never done team teaching; this was supported when the researcher did classroom observations because teaming was not present. This strengthened the need for the research study because teachers expressed the need for greater support, collaboration and guidance so that they can improve their instructional delivery. In addition, to strengthen the desire of the teachers for greater support, three of the teachers indicated that they were given planned lessons to teach but some areas were not done due to the lack of guidance and support that was needed for implementation of the activities. The final competency that was outlined on the checklist was related to professional development. Three of the four teacher-participants never attended a PBL session and/or technology workshop. One teacher attended PBL workshops before but did not enact the strategies in the classroom due to the lack of guidance.

Table 3

Needs Assessment: PBL Checklist for Classroom Visits

<table>
<thead>
<tr>
<th>PBL required Competencies</th>
<th>Teacher 1</th>
<th>Teacher 2</th>
<th>Teacher 3</th>
<th>Teacher 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responses</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Pedagogical Beliefs</td>
<td>17%</td>
<td>83%</td>
<td>33%</td>
<td>67%</td>
</tr>
<tr>
<td>Technology use for higher order thinking</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>Planning and Organization</td>
<td>17%</td>
<td>83%</td>
<td>33%</td>
<td>67%</td>
</tr>
<tr>
<td>PBL required Competencies</td>
<td>Teacher 1</td>
<td>Teacher 2</td>
<td>Teacher 3</td>
<td>Teacher 4</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>Classroom Management skills</td>
<td>33%</td>
<td>67%</td>
<td>44%</td>
<td>56%</td>
</tr>
<tr>
<td>Collaboration</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>Professional Development</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>Total</td>
<td>21%</td>
<td>79%</td>
<td>25%</td>
<td>75%</td>
</tr>
</tbody>
</table>

Table 3 indicates that below 36% of the required elements for a problem-based learning classroom was present in the classrooms that were observed. Over 60% of the required PBL best practices were not present in any of the classrooms that were observed. From this data, the teacher-researcher planned the intervention that was needed to proceed in the research study.

**Qualitative Results**

Qualitative results from at this stage of the research study were analyzed from pre-interviews that were semi-structured in nature, field notes/ memos, and secondary sources. Semi-structured pre-interviews were conducted and eleven focused codes emerged through analysis. The secondary sources included, school charter/policy, existing lesson plans, and curricula. All curricula for Grades 7-10 in science and mathematics were reviewed. Initial, focused, and axial coding procedures were used to analyze these data. These codes were reanalyzed to allow the researcher to gain a deeper understanding of what the data were indicating. From this process, six themes emerged and these are identified and defined in Table 4 and are discussed in more details later. It was also noted that from the field notes/memos the same major themes emerged from the coding process.
Table 4

Needs Assessment: Emergent Themes for Qualitative Data

<table>
<thead>
<tr>
<th>Theme</th>
<th>Operational Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support</td>
<td>Having close pedagogical assistance and guidance for the implementation of teaching strategies and procurement of classroom resources.</td>
</tr>
<tr>
<td>Confidence</td>
<td>The ability to be certain and comfortable</td>
</tr>
<tr>
<td>Professional learning</td>
<td>How professional learning is viewed and planned to improve teachers’ instructional delivery</td>
</tr>
<tr>
<td>Knowledge</td>
<td>The facts, information and experience gained about the topic and related areas</td>
</tr>
<tr>
<td>Collaboration</td>
<td>The ability to work in teams for planning and implementation of lessons</td>
</tr>
<tr>
<td>Culture</td>
<td>The practice or custom of a school/class</td>
</tr>
<tr>
<td>Teacher-Led</td>
<td>Activities in the classroom are directed and planned by the teacher.</td>
</tr>
</tbody>
</table>

Support

Support was a recurring theme in the pre-interviews for all teacher participants as well as in the data for the field notes/memos. Support is defined as having close pedagogical assistance and guidance for the implementation of teaching strategies and procurement of resources. In general, the teachers believed that through support and guidance, they would be able to do better professionally which would eventually improve the teaching and learning experience for students. The teacher participants have the potential to be supported directly by the principal, deans at the school and curriculum leads. There were some instances when the teachers felt supported by their superiors but all participants believed that if more support/ guidance were given after professional workshops or interventions they would be able to improve their teaching strategies and delivery in the classroom. The teachers expressed that even after attending a PD workshop there was need for more support to implement instructional strategies that were taught. Teacher 1 made this evident by stating:
I feel like I don’t have enough guidance and you are left in a space where you are the only one really evaluating your progress. Often times, it is easy to fall in a trap like nothing is good enough and I am not doing a good job.

Another participant (T2) explained that staff development just happens and said: “Staff are just expected to be at a certain level or point and you are left to figure out a way to get there.” On the other hand, Teacher 3 believed that for this school year there was more support from the supervisor. In addition, the teacher indicated that in the past,

It felt more like the pace was to get things done no matter how it should be achieved, but this school year there seems not to be a huge rush to get topics done but there has been a bigger focus on re-teaching of topics if it had to be done.

Data from the field notes/memos also indicated the needs for teacher support and guidance. During classroom observations, the researcher noted that teachers were given planned science lessons for delivery of content but there was no co-planning done between the teacher and supervisor. The lessons were written with the relevant activities but some areas were not clearly understood by the teachers. In one of the science classes, the teacher was uncertain how to enact some parts of the lesson, so it was adjusted to match the teacher’s comfort level.

Another teacher from the other department was given a curriculum framework with a pacing guide to indicate what activities students should complete for the week. During this classroom observation, students were seated in groups to complete an activity in small groups, but they were unaware how this would be presented for grading or how applicable it was to their daily lives. Pedagogical assistance was not obvious during the class visits. These observations strengthened the data that were collected during the pre-interview when the teachers indicated that there was need for support and guidance for the implementation of new instructional
strategies in the classroom. On the other hand, one science teacher indicated, that having support and guidance would help when resources and other teaching strategies are necessary for challenging topics.

Confidence

Another major theme that emerged in the pre-interview was confidence. During the pre-interview, teachers expressed a lack of confidence to implement new strategies after a workshop session. They also expressed the fear of enacting some types of strategies that included discussions or student-movement in their classrooms. This also led to non-action after some professional development sessions. Teacher 1 indicated that problem-based learning was taught in a workshop session before and agreed that PBL was important to assist students to develop 21st century skills. However, the teacher indicated:

I have not done it yet because I just never felt super confident in the planning piece and to provide students with the information that they are going to need to be successful in those learning experiences.

Another participant, on the other hand, expressed fear of utilizing teaching strategies like problem-based learning in classes because the teacher did not know how well groups would work together and discuss content topics. The teacher stated: “I know that certain groups will work well together and I fear sometimes that some groups won’t do anything if they don’t have certain types of students in their group and I am afraid of them failing.”

Teacher 4 also concurred with this same point by expressing fear of implementing new strategies in the classroom by indicating that:

It goes back to crashing or burning in my face, so I have taught for only three years and it is more like lecture style and then practice problems. A lot of what happens in the
classroom goes to the mindset of students and then I just have a fear of it crashing and burning when another strategy is introduced.

From the researcher’s field notes, some teachers expressed how fearful they would be if they were asked to implement problem-based learning strategies in their classrooms. Teacher 1 indicated: “that would not happen, because as a teacher who has been to workshops before, I would not know the first step to plan for this implementation.”

**Professional Learning**

Professional learning was identified as a major theme as teacher participants expressed their thoughts about the school’s professional or staff model. Professional learning involves the steps taken by the school about the plans to improve teachers’ instructional delivery. Data from the pre-interviews indicated that participants believed that professional learning should be a more organized activity by leadership. In addition, teachers indicated that differentiation of learning for staff should be highly considered. They believed that if professional series were better planned, these would be more beneficial for them in the classroom. One teacher indicated: “I think professional development is just a thing that just happens now (laugh), it does not seem like it is something that someone really, plans for and executes at the school.”

Data from another teacher strengthened this notion as this was stated: “I feel that the professional development which is done is just inconsistent and has not been really developmental at least for me.”

Teacher 3 viewed professional development as a way for administration to examine the things that teachers are not strong or competent in and then provide time to learn and practice them with someone who is doing better. This participant indicated that: “being in a room and
getting instructions is not very vital to professional growth and learning; this model is seen very often at the school.”

One teacher who worked at the school for many years indicated that over the last two years, professional developmental series have improved. This was the description:

I think in the last two years our professional development and learning have improved quite a bit, especially around teaching strategies and how to manage your classroom, ideas and activities how to engage our students. However, I wish sometimes that differentiation was done between newer teachers and those who have some experience just to expand some of what we were exposed to and what could be done in the classroom to improve students’ learning.

**Collaboration**

Collaboration among educators has been viewed as one of the main elements to success in teaching and learning (Fullan, 2007). The teacher-participants in this study indicated that they have seen much benefit when they are allowed to collaborate in teams, which has happened in the past. One participant indicates that:

I think break-out sessions are actually more vital to what we do because it gives us a chance to not only learn from management but it allows us to learn from peers. Whether people believe it or not, but learning from each other is really big for us because it gives us the chance to see what strategies are working.

Another participant indicated that effective professional development is closely related to how it is done:

I think learning new teaching strategies, working with teams and being coached seems like for me, at least, what professional development should be. That is what I would
benefit from the most when I go to weekly professional development interventions.

While there are huge benefits to teacher-collaboration that contribute to personal, professional and students success, one participant indicated that this interaction is great when the mindsets are right and the process is taken seriously. This was stated: “professional development should be collaborating with your peers on weaknesses that you may have or something that maybe new that is brought to the school.”

Data from the field notes also indicated that participants believed that collaboration is important for staff growth and it can shape how new teaching strategies are implemented in the classroom. The teachers believed that if the teaching staff does training, this would promote growth and greater collaboration because the teacher would be available to answer questions or make suggestions. This was evident when Teacher 3 said: “learning from each other is big, and if colleagues do professional development, they would be available after the session to help because they would be in the building.”

Data from the secondary sources had different sections that referred to collaboration but the charter/policy document was more direct because the school has different learner expectations with “collaborator” being one. The charter indicated: “students will be taught to be collaborators, problem solvers, empathetic citizens, researchers and knowledgeable people. The curriculum allows students to investigate these pillars of an educated person specifically through the theme of social justice.”

In addition, the charter indicated the desire for teachers to collaborate with each other to improve student achievement. This was seen: “teachers will work together as teams to plan intervention for students who are not within the 75 % mastery of content knowledge.” During
the classroom observations, the level of collaboration that was expected and stated in the school’s charter was not evident.

**Knowledge**

When fostering transformative learning the awareness of the context allows for deeper appreciation and understanding of the personal and professional situation of the individuals at the time, this includes the prior knowledge of participants (Mezirow & Taylor, 2009). From the pre-interviews, teachers did not have much knowledge about the teaching strategy or coaching. One participant stated that problem-based learning workshops have been attended in the past but was never taught how to implement it in classrooms. In addition, the participant explained that with the lack of knowledge for implementation it was never attempted. The participant continued:

So I get project-based and problem-based confused quite a bit. My understanding of problem-based learning is that you present students with a problem relating to the content that you are teaching, then through mini-lessons that you do they use their content knowledge and solve the problem - I am not sure.

This participant was the only one who had ever experienced teacher coaching. This was indicated by the teacher: “It is really important to have another set of eyes in your classroom, then specifically get coached for what you can get better at and also to notice the good things that sometimes in the moment get missed.”

From the meetings held during this stage two teachers indicated that they do not know about problem-based learning strategy as a teaching method; however, they use worded problems in their classroom. One teacher indicated that the only information known about PBL was in graduate school but was never trained in the instructional strategy. Teacher 2 indicated
that there is a level of openness to be coached even though there is uncertainty about what to expect. One participant attended PBL workshops at the school, but has never enacted the strategy. The teacher indicated that: “There is no way I would be able to create a problem for my lesson, I just don’t know how, without the appropriate support and guidance to do so.”

**Culture**

Culture is defined as the practice or custom of the school or classroom. Coaching is a powerful, confidential and non-evaluative process where two or more colleagues can be benefited to improve teachers’ praxis (Robbins, 2015). Even though this has proven to be a great tool, one participant indicated: “I think coaching will be very uncomfortable here at first, since we do not have that culture, but I hope to experience the benefit of it.” Teacher 3 agreed that even though coaching teachers is not a part of our culture: “If done properly, I think it is a really good tool.”

Data from classroom observations showed the teacher as the leader for planning, and implementation of activities; this custom was seen in all the classrooms that were visited. In addition, students were seated in rows of chairs and desks and group work was not seen. Two teachers who have been at the school for more than three years indicated that coaching and classroom visits by other teachers were never seen. This was stated: “coaching is not our culture, so it may initially feel awkward but I believe a level of trust will be developed over a period.”

An additional theme emerged from the secondary sources that were reviewed. This emergent theme is defined in Table 4.

**Teacher-Led**

Teacher-led activities were prevalent in the lesson plans that were reviewed. This refers to the classroom activities that were planned and directed by the teacher. Lessons that were
planned by Teacher 1 reflected all activities as independent work for students. In addition, for both math curricula, the teacher was the leading person in the classroom for content delivery. From the needs assessment, results revealed that classes were teacher-led with little to no evidence of students’ collaboration. These observations are the opposite of what is written in the school’s charter.

**Action Research Cycle**

The action research cycle for the research included Iterations 1, 2 and 2 and 3. In Iteration 1, the researcher conducted problem-based learning training sessions and coaching awareness sessions for all the teachers, who participated in the research study. During this iteration also co-planning of lessons and modeling of activities for the lesson were done. This was done because data from the needs assessment indicated that only one teacher had workshop training in PBL strategies but did not implement this because of lack of knowledge, guidance and support to do so. Iteration 2, sought to enact the instructional strategies in classes using the peer-coaching model. During these iterations, qualitative data were collected using field notes/memos, teachers’ reflections and researcher’s reflections. In addition, quantitative data were collected using the PBL behavioral checklist (see Appendix F) during Iteration 2. This was used for classroom observations.

**Iteration 3**

In Iteration 3, the teacher-researcher sat with individual teachers in meetings and completed the selection of topics and planning of lessons. For all lessons that were planned, the problem-based learning lesson template was used (see Appendix A). Using the coaching model as outlined by Robbins (2015), after the awareness session, direct instruction, modeling and support applications were actioned (see Appendix L and Appendix M). Results are presented
using the different data strands. Qualitative data were collected using teachers’ reflection notes, field notes/memos and researcher’s reflection. Initial, focused, and axial coding procedures were used to analyze these data. There were common emergent themes for the three sources and culture was added to the teachers’ reflection themes. The common themes discussed are collaboration, guidance and support, reflection, prior knowledge, student-centered and culture. Table 5 outlines the emergent themes and the operational definition.

Table 5

Emergent Themes for Qualitative Sources for Iteration 2

<table>
<thead>
<tr>
<th>Theme</th>
<th>Operational Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaboration</td>
<td>The ability of participants, students and researcher working together to achieve a common goal.</td>
</tr>
<tr>
<td>Prior Knowledge</td>
<td>Information learned that guides adjustments of personal and professional situations of the teacher.</td>
</tr>
<tr>
<td>Guidance and Support</td>
<td>Providing leadership for the planning and implementation of instructional practices through modeling, acquisition of key resources and provision of positive feedback.</td>
</tr>
<tr>
<td>Reflection</td>
<td>Deep thoughts, evaluation and consideration of what is done in the classroom.</td>
</tr>
<tr>
<td>Student-centered</td>
<td>Classroom activities are directly related to students’ planning, implementation and inquiry activities.</td>
</tr>
<tr>
<td>Culture</td>
<td>The strategies that are used by staff and students to create acceptable beliefs, values and assumptions that are shared.</td>
</tr>
</tbody>
</table>
Collaboration

Collaboration was identified as an emergent theme for all qualitative data sources. Teacher-collaboration was a main action during the coaching process; the goal was to successfully implement a new teaching strategy in classes, which is student-centered (PBL). Throughout this iteration, collaboration was evident among students during the classroom visits among teacher and students, students and students and teacher and researcher. During the classroom observations, students were seen collaborating in groups to complete different activities that led to the solution to the problem that was given. This was evident when students brainstormed ideas for their learning boards. Teachers worked closely with different groups during class sessions to guide the process of completion for activities that led to the solution for the problem given in the lesson.

Dialogue and collaboration were consistent actions throughout the process as the teachers and the researcher reviewed units, lesson topics and planned the PBL lessons together. Lessons were planned using the PBL lesson plan template (see Appendix A); these were done individually by grade level (N=4) with the science teachers.

Prior Knowledge

Data from the teachers’ reflections indicated that the participants were feeling more comfortable having some knowledge about the PBL strategies. They expressed that now that they have knowledge and demonstrations/modeling of lessons was done, they felt confident to implement the strategy. One teacher stated: “just to know that I have the knowledge of how a problem can be formulated to integrate many subjects, I can better see what my class will look like as I progress through the plan.”
Another teacher indicated that they were aware that problem-based learning strategy had proven to be successful in the past. However, just to see how it is now unfolding, students can really use knowledge that was gained in previous lessons to help them to figure out the solution to the problem given. On the other hand, one teacher stated that having knowledge of problem-based learning helps in harnessing key information that the students already know about the topic. This was evident when the teacher stated: “doing a class’ learning board with discussion really taps into finding out what the student already know about the topic, which allows for easier scaffolding of the lesson.”

**Guidance and Support**

Providing guidance and support for teachers in the classroom help to provide teachers with important tools and strategies for students learning and development. Teacher 1 indicated that with the support of the researcher as coach, some classroom resources were developed which helped in the smooth execution of the new strategy. The teacher stated:

I also got to create some graphic organizers with the coach which helped with differentiation in the classroom; so I felt confident when providing the information to my students during the lesson because this was reviewed and activities were modeled when necessary.

Data from Teacher 2 also strengthened the data from another colleague as they indicated that having someone to assist in planning the problem-based learning lessons and to provide modeling for different sections made the process easier and more manageable. This was also evident when classroom observation was done, when the lesson for Teacher 2 was enacted, how it was modeled and was able to anticipate questions that the students would have
Teacher 1 in the reflection journal indicated that, having someone who was available to answer questions during this stage was great. This was evident as the teacher said: “during the process, having the researcher as a coach, I could always ask clarifying questions, brainstorm ideas of how to improve each class and the upcoming cycle. This gave me enough confidence to do these PBL lessons.”

Another teacher-participant indicated that support was critical for the enactment of this new strategy in the classroom. This was evident as the participant wrote: “coaching also provided the emotional support for overcoming and tackling a new challenge that at times seemed intimidating.”

One teacher, during the initial stage of planning the lesson, seemed resistant as some questions were asked and coaching proceeded. The teacher indicated later during the research study by saying this:

I was nervous about the coaching process and this new strategy so I asked all the questions to seek clarity. I have never experienced working with any teacher or supervisor so closely to plan lessons so it was new and created some level of anxiety.

During class observations in Iteration 1, this teacher was noticeable providing more support to students by circulating throughout the class. The teacher was also asking open-ended questions that were related to the topic and activity that were being worked on.

**Reflection**

Reflection is considered an important element of adult learning; this happens when people question the integrity of the expectations and views that were once held due to their previous knowledge (Mezirow, 2009). In Iterations 2 and 3, reflection was an emergent theme in the data for field notes and researcher’s reflection journal. Reflection here is defined as deep
thoughts, considerations and evaluation of activities that were done in the classroom. When this was done, it influenced changes that were made for future lessons and Iteration 3. The teachers acknowledged that they knew the value of reflection, but this was not written and time was never used to consciously reflect on each element of the lesson and activities in the classroom. In addition, teachers indicated that:

This is new, and reflection was never done orally or written with colleagues after a lesson is taught, but I found this process to be interesting and informative since it was not evaluative like when a supervisor came into my room.

During the coaching process, the researcher encouraged informal and formal meetings to solicit feedback about the enactment of the instructional strategy. This process of reflection and dialogue between the teachers and researcher allowed for open communication when there was a lack of comprehension about an activity. This was evident as the researcher sought to clarify some areas during the first few weeks of Iteration 1. The teacher stated: “how do I facilitate the research for appropriate labs for the physical science group that is doing rocks, volcanoes and effects in relation to the Hawaii problem that was given?”

The teachers saw the value of reflection so upon class observation, the researcher was able to identify that student reflections were also implemented in the classroom. The PBL checklist also gave credence to the value of reflection; during classroom observation, this was said by one teacher: “remember while another group is presented we will complete the reflection and evaluation sheet for each group. Remember to indicate one thing that the group did well, that is “shine” and one thing that they could improve on (sharpen).”

Another teacher indicated that the reflection at this stage of the process, made room for things to be slightly adjusted in order to experience greater success. The teacher also explained
that students were able to cover more content in the subject area using an integrated approach, which included different disciplined. This was evident as the teacher stated:

After reflection, I recognized that students were able to cover a much wider range of information, in greater depth and using different subject disciplines. This was done because of the problem-based approach; this would not have been experience in my regular classroom setting.

During the coaching process, the researcher also utilized reflection to see what areas should be improved. Adjustments were made during and after this cycle to ensure more success in Iteration 2. The post-conference after the class observations in Iteration 1 provided opportunities for the teachers and coach to share their reflections on the lessons that were observed. This process was used to examine the data collected and how this would influence the lessons in the future (Robbins, 2015).

**Student-Centered**

Student-centered was an emergent theme that was evident only in the field notes, which were collected and analyzed from the classroom observations. This theme is defined as classroom activities that are directly related to students’ planning, implementation and inquiry activities. Student-centered teaching puts students in the center of the teaching and learning experience where activities are engaging, interesting and intriguing to students (Gheyssens et al., 2019). Differentiation is also encouraged during a student-centered environment. During the class observation, students were seen in groups, collaborating and working towards the solution of the problem that was posed in the lesson. The teacher was seen as a facilitator of learning as students worked with each other to create learning boards, do research and collected data. In another lesson that was observed, students were seen with their lab report papers from their
research, gathering materials and completing labs from the information that they identified and collated in response to the possible solution to the problem that was posed.

**Culture**

Culture can be defined as the freedom to feel safe to use strategies in the classroom that will create acceptable beliefs, values and assumptions that are shared. Fullan (2007) explicates that instead of restructuring a school, “re-culturing” is need. The author continued to explain that educators must question their beliefs about teaching and be willing to engage in a collaborative process for change to create a more inclusive school (Fullan, 2007). In Iteration 2, the teachers indicated that there was a change of culture for their classroom that they have now embraced. According to Teacher 1: “at first, becoming a facilitator was difficult for me, but I quickly realized that in giving students freedom for inquiry around the problem given, students started to fit in where they felt were their strongest areas.”

Another teacher indicated that: “the culture of the classroom made a positive shift towards a more supportive collaborative atmosphere.” In addition, the teacher indicated that students became more responsive and responsible for their learning. The teacher stated: “since all students worked collaboratively in groups and being recognized or held accountable for how active they participated in their groups, students became more invested and excited to share their results.” This was also seen when the researcher did class observations.

**Quantitative Results**

During Iteration 2, quantitative data were collected and analyzed using the problem-based learning checklist that was completed for each classroom observation that was done by the researcher. Table 6 indicates six main competencies that are outlined in the PBL checklist. The competencies that were measured include pedagogical beliefs, technology use for higher-order
thinking, planning and organization, classroom management skills, collaboration and professional development.

Iteration 2 showed a difference in the responses when compared to what was indicated or evident in the data for the needs assessment. In this iteration, pedagogical beliefs, which focused on student-centered activities, in both teachers’ class over 50% was evident. During the observation over 80% of the requirements as outlined on the document was present in one of the classes. Planning and organizing is another competency that was listed on the checklist. Teacher 2 had all 6 best practices measures evident in the class, and teacher 1 had 4 out of 6 that were evident. For the competency that is related to classroom management skills, both teachers had 7 out of 9 best practices evident in their classes. Both teachers experienced collaboration and professional development as outlined on the checklist.

Table 6

*Iteration 2: PBL Checklist for Classroom Visits*

<table>
<thead>
<tr>
<th>PBL required Competencies</th>
<th>Teacher 1</th>
<th>Teacher 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responses</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Pedagogical Beliefs</td>
<td>67%</td>
<td>33%</td>
</tr>
<tr>
<td>Technology use for higher order thinking</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>Planning and Organization</td>
<td>67%</td>
<td>33%</td>
</tr>
<tr>
<td>Classroom Management skills</td>
<td>78%</td>
<td>22%</td>
</tr>
<tr>
<td>Collaboration</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>Professional Development</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>Total</td>
<td>79%</td>
<td>21%</td>
</tr>
</tbody>
</table>
Table 6 indicates the data from the problem-based learning checklist that was used for the classroom visits for the science classes. After the intervention, the data indicated that over 79% of the PBL elements were evident in the classes that were seen. In the classroom taught by Teacher 2, only 14% of the required best practice elements were not seen in the class. In addition, 21% of these elements were not evident in Teacher 1’s class.

**Iteration 3**

**Qualitative Results**

Qualitative data were collected and analyzed from Iteration 2, using various data sources. The data sources that were used in this iteration were teachers’ reflections, field notes, researcher’s reflection and post interviews. The post interview was semi-structured in nature and was done at the end of Iteration 3, after the completion of classroom observations. The post interview was conducted using a focus-group approach. The emergent themes were common in most areas, however; the teachers’ and researcher’s reflections had two new themes, authentic relationship and dialogue. The emergent themes for teacher’s reflection, field notes and researcher’s reflection were culture, change, support and guidance, dialogue and authentic relationship. In this section, results from the emergent themes citing examples from data sources will be presented. Table 7 outlines each theme and operational definitions for the qualitative data strands.

Table 7

<table>
<thead>
<tr>
<th>Theme</th>
<th>Operational Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change</td>
<td>The ability to modify the instructional practice to create a more student-centered classroom.</td>
</tr>
<tr>
<td>Dialogue</td>
<td>The facilitated conversation between the teachers and researcher that provides an opportunity for sharing of experience, assumptions and beliefs.</td>
</tr>
<tr>
<td>Theme</td>
<td>Operational Definition</td>
</tr>
<tr>
<td>-----------------------</td>
<td>----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Guidance and Support</td>
<td>Providing leadership/assistance for the planning and implementation of instructional practices through modeling, acquisition of key resources and provision of feedback.</td>
</tr>
<tr>
<td>Reflection</td>
<td>Deep thoughts, evaluation and consideration of what is done in the classroom to improve teaching and learning.</td>
</tr>
<tr>
<td>Culture</td>
<td>The freedom to feel safe to use strategies in the classroom/school that will create acceptable beliefs, values and assumptions that are shared.</td>
</tr>
<tr>
<td>Authentic relationship</td>
<td>The ability to establish positive and productive relationship with others that is underlined by trust that gives confidence to be open for change.</td>
</tr>
</tbody>
</table>

**Dialogue**

“Dialogue is the medium for critical reflection to be put into action, where the experience is reflected on, assumptions and beliefs are questioned, habits or minds are ultimately transformed” (Mezirow, 2009, p. 9). In Iteration 3, dialogue is defined as the facilitated conversations between the participants and the researcher that provide an opportunity to share their experience, assumptions and belief. Also, how that influenced the enactment of PBL through the professional development initiative (coaching). The teachers felt supported and open, as well as they developed a level of trust that they were willing to ask questions and seek to make adjustments. This was stated by one teacher:

> If it wasn’t for the constant meetings and check-ins, I would allow my fear to get to me and would not try to implement problem-based learning in my classroom. It was good having morning check-ins to find out how I was doing and if there were any final questions before the day’s teaching began. These conversations were helpful.

Another teacher indicated how beneficial dialogue was, the teacher said: “conversations with my coach helped me to see the possibilities and let me give my students more options, than I originally thought were possible as the learned a new topic.”
**Authentic Relationship**

According to Mezirow (2009), authentic relationship fosters transformative learning and allows individuals to have questioning discussions, share information openly and achieve mutual understanding. During this research study, teachers expressed the fact that positive, productive and trusting relationships were built; which created a level of openness during the coaching process and the PBL cycles. This was evident as one teacher indicated:

I think coaching makes staff closer, which means we collaborated more. I think we have a lot more interest in what others are doing in their classrooms. Like my science colleagues I have never been able to see other teachers’ stuff that they are doing.

**Support/Guidance**

Support and guidance was an emergent theme at all stages of this research, however for this iteration the data showed the positive impact that this had on the participants. According to Teacher 4: “If it wasn’t for the coach and how often we met for planning, constant communication and modeling, I wouldn’t have been as willing to try and go through with PBL. I really don’t know how well this would have gone, without this help from my coach.”

The data showed that Teacher 2 indicated that anxiety was evident at one point in the PBL cycle but having the support of the coach made life easier. This was said:

Having groups of students all complete their own labs relating to the solution of the problem given, made me very anxious and nervous. Help from my coach and the support that I had in the room on the day and the level of structure that the students had surprised me. The lab was successful. I felt good about the students’ achievement.
Another teacher indicated that on several occasions that the enactment of the new teaching strategy would not have been possible without the sustained professional development. This was evident as the teacher said:

The difference of seeing PBL in a workshop setting in comparison to what happened over 3-4 months with you was good. I have probably seen PBL in workshops about four or five times, but not once was I motivated to try - I just did not know how to do that. I have now gone through two cycles and feel very comfortable to do this again. This was because of the support and guidance received from coaching.

Data from the post interviews indicated that Teacher 2 explained that doing lesson planning with the coach was beneficial, as a lesson plan was not handed to the teacher and asked to teach from it. This was said:

Co-planning of PBL lesson was beneficial because I could learn from the stage of creating a problem and the related activities and to be comfortable with the process and pieces even before starting the lesson - this should happen more often.

**Culture**

The teachers expressed that the implementation of PBL in their classrooms using peer coaching has changed their classroom culture. Culture is defined as the freedom to feel safe to use strategies in the classroom/school that will create acceptable beliefs, values and assumptions that are shared. From the post interviews, the teachers expressed that after the sustained professional development, a different culture was developed in their classroom. In addition, they indicated that this process has changed the culture for them personally and professionally. This is so because they had never experienced co-planning and someone in their class to guide them in the delivery of their content. One teacher indicated:
I think it is important to note just how much was done in five weeks or so. Like the amount of work; you can look at the charts on the walls, you can also look at labs that have been done.

Another teacher stated that: “The culture of the classroom made a positive shift towards a more supportive collaborative atmosphere.” One teacher’s reflection stated that classroom culture was different, and this was evident as this was said: “A lot of students came into the class excited because the new teaching strategy had switched up our daily lessons and they had hands-on work to do, they were motivated to learn.”

To strengthen the importance of what changes culture can have on the teaching and learning environment, data from one teacher’s reflection indicated that the teacher believed that if professional development were done like this and sustained over a period, the school’s culture would be positively impacted. The teacher said:

Coaching improves the culture. This process created interest and you just want to know what people are doing, what PBL looks like in the different areas and what I can learn. I think that a change in culture amongst staff especially one that is as small as ours could be powerful. This would improve teaching across the board and just improve school culture in general.

Finally, another teacher indicated that they have seen the students using and developing so many skills in a short period, which was incredible. This was evident as the teacher stated:

Just to see the students using so many skills in a short time and be able to celebrate their achievement, I think it was able to also just change the culture of the room. Also, students got some freedom at what they looked at and how they would put different pieces together to come up with a solution.
Change

Change is the defined as the ability to modify the instructional practice and to create a student-centered classroom. One teacher indicated that the tools for implementing PBL were not provided before the coaching experience hence it was never introduced in the classroom. From one teacher’s journal reflection, this was stated:

I never felt like I was actually provided the tools from any workshop to execute this strategy appropriately in my classroom. This experience with the co-planning and coaching built-in, allowed me to feel very successful and excited to continue to grow this system in my classroom moving forward.

Another teacher indicated that: “I firmly believe that I would not have been able to be as successful as I was in executing this new strategy without the help of my coach.”

During this iteration, the teachers indicated how this professional development experience have allowed them to implement the new teaching strategy and they have seen a change in their delivery and they do not want to go back to how they taught in the past. This was evident as one teacher said:

Having been through this process, I really do not want to go back to how I was teaching in the more traditional way. It was cool to see my kids learning in this student-centered way, so frankly, it was the difference between me not knowing and doing, and being coached. I did it and feel like I could continue to build on it now.

Another teacher stated:

I think this process was probably one of the most effective professional development pieces that I have experienced in my teaching career. When you have someone’s eyes on what you are doing and giving ideas for change, it makes a world of difference.
Reflection

At the onset of the research study, teachers explained that they had not been involved in critical reflection after completing a lesson or unit. They indicated that after going through Iteration 1, it became a habit to do reflection, and they would record the things that went well and what things could be improved the next time. One teacher indicated that this coaching process had guided this important step, which was never formally practiced. The teacher said: “I think coaching was really great in more than one ways and if we did more coaching in this school a lot of teachers would benefit from it.”

Another teacher indicated that: “After going through both iterations, I feel very confident in moving through the pieces now and feel as though I can even build on the skills and what I have learned.”

Reflection involves deep thoughts, evaluation, and consideration of what is done in the classroom to improve teaching and learning. From the post interview, one teacher indicated that the reflection at this stage of the process, made room for things to be slightly adjusted in order to experience greater success. The teacher also explained that students were able to cover more content in the subject area using an integrated approach. This was evident as the teacher stated:

After reflection, I recognized that students were able to cover a much wider range of information, in greater depth and using different subject disciplines. This was done because of the problem-based approach; this would not have been experience in my regular classroom setting.

The teachers also expressed that because they were asked to do the reflection journal for the research study, it allowed them to see how much students had done throughout the PBL cycle. In addition, they could see how much the student had learned through collaboration and
receiving the needed guidance and support through this process. This was expressed by one teacher in this way: “The experience, together allowed the teacher and students to see how much they had learned and accomplished in a short time. I was amazed the various activities and work done by the students as they explored the topic.”

**Collaboration**

Collaboration has been an emergent theme for all stages of the research study; data for this iteration were from the focus group interview. Teachers expressed that it was important and beneficial for teacher-collaboration during the sustained professional development series. One teacher indicated that the most beneficial aspect of the coaching process was having the opportunity to do planning and modeling of the PBL strategies with the coach. The teacher stated:

The most impactful parts for me during this process were the planning and having access to my coach at all times throughout the process.” In addition, “planning with my coach allowed me to hear the descriptions of what to do, ask questions through the planning and modeling stage, so I recorded the information that I felt that I needed in order to be successful.

Teacher 2 explained that coaching was beneficial for the implementation of problem-based learning in the classroom. The teacher continued by expressing that coaching provided the support needed to be comfortable as something new was introduced in the classroom. This was evident as the teacher stated: “Coaching and modeling provided a guideline for how to implement PBL in my classroom in a way that was comfortable and tailored to the needs of my students.” In addition, the teacher stated: “Coaching gave me the support that was need as it gave
me another perspective and set of eyes that I could use to problem solve the issues or problems that I anticipated having in my classroom.”

**Quantitative Results**

Quantitative data were collected and analyzed using the problem-based learning checklist. During Iteration 3, all six classes taught by the four participants were visited and observations were done for over 45 minutes. Upon analysis of the data, there was an increase in the number of best practices for each competency seen in the classroom. All teachers had an increase of over 20 best practices out of 28 in total. Teachers 1 and 2 had the highest number of conformance of the best practices seen in the classes that were visited. These two teachers experienced coaching throughout both iterations. For the required competency “collaboration” Teachers 1 and 2 had 1 best practice that was evident and the other was not. The best practice that was not evident was collaboration with other teachers in planning and team-teaching. It was deliberate that the researcher was not initially involved in planning of the lesson with the teachers. This process assessed what they achieved in Iteration 2 and then what areas the coach would still need to guide them through for successful enactment of the new lessons in Iteration 3.

Table 8 gives the indicators of what competencies and best practices were obvious during class observations. Also, Table 8 provides data that indicate that over 75% of the best practices elements were seen in all classes that were visited for the math and science teachers. The data show the highest evidence of the best practices was in the science classes that were taught by Teachers 1 and 2; 93% and 86% respectively. It is important to note that these teachers went through the cyclical process two times during the action research cycle.
Table 8

PBL Checklist for Classroom visits

<table>
<thead>
<tr>
<th>PBL required Competencies</th>
<th>Teacher 1</th>
<th>Teacher 2</th>
<th>Teacher 3</th>
<th>Teacher 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responses</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Pedagogical Beliefs</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>67%</td>
<td>33%</td>
<td>83%</td>
<td>17%</td>
</tr>
<tr>
<td>Technology use</td>
<td>75%</td>
<td>25%</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>for higher order thinking</td>
<td>50%</td>
<td>50%</td>
<td>25%</td>
<td>75%</td>
</tr>
<tr>
<td>Planning and Organization</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>83%</td>
<td>17%</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>Classroom Management</td>
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<td>0%</td>
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<td>11%</td>
</tr>
<tr>
<td>skills</td>
<td>89%</td>
<td>11%</td>
<td>78%</td>
<td>22%</td>
</tr>
<tr>
<td>Collaboration</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>Professional Development</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
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<td></td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>Total</td>
<td>93%</td>
<td>7%</td>
<td>86%</td>
<td>14%</td>
</tr>
</tbody>
</table>

Summary of Results

In summary, the teachers indicated in the needs assessment that they did not know about problem-based learning. One teacher of science explained that workshops were held in the past on problem-based learning but enactment was never done due to not having enough guidance, knowledge, support and understanding on how to implement the lessons. The teachers explained that they do not believe that professional development was carefully planned by administration and there should be a more thoughtful way to plan interventions for staff. Some teachers indicated that even though they were involved in weekly professional development there should be differentiation because a first year teacher would need some intricate guidance and
interventions when compared to a teacher of three or more years of experience. Teachers also indicated that they had never been coached before, and they were never involved in any professional development that was extended over a period. Given this fact, the teachers were never exposed to anyone working so closely with them on their lessons and lesson plans or having anyone visiting their classes and providing feedback that was evaluative. The teachers felt that it would be uncomfortable and daunting initially, but was helpful for their professional career.

During all stages of this research study, teachers spoke about the lack of support and guidance from administrators for implementing teaching strategies. In the needs assessment, there was constant discussion about the need for teacher support and guidance when professional development workshops are done, and staff is asked to implement new strategies. Problem-based learning was taught in a workshop setting to only one teacher who was involved in this research study. Due to this knowledge, the researcher had to train all teachers in PBL using the coaching model as outlined by Robbins (2015). As the study progressed, the discussion from the teachers shifted from the need for support and guidance, to gratitude for support from the coaching process to enact the instructional strategies. During the process, the teachers received support and guidance for selection of the topics, co-planning of the lessons, modeling of activities and implementation of the lessons.

From classroom observations, field notes and interviews lessons were teacher-directed and the classroom was dominated by teacher-planned activities. As sustained professional development progressed, the classroom culture was converted from teacher-led to student-driven activities. Student collaboration was obviously improved due to the approach that was implemented in the classroom. There was also greater collaboration between students and
teacher, and teachers and the researcher, who served as the coach. Teachers believed that if sustained professional development continues, there would be a change in the school culture as teachers would be able to collaborate with each other and support would be more evident by administrators. In addition, if coaching is done, it builds trust over a time and authentic relationships are formed. This would provide greater teamwork amongst staff that would improve students’ learning and growth.

The teachers that participated in the research study expressed that the change they experienced the most was in their professional growth. In addition, the teachers compared their delivery in the classroom before the study to the changes that were seen at the end of Iteration 2, and explained that they do not want to go back to their former teaching style. Furthermore, the teachers expressed that after going through this coaching experience they were more comfortable in using this instructional strategy in their classroom. They can build on what they have learned to improve the delivery of the curricula.

**Data Merging/Triangulation**

Triangulation provides the reader with an embedded approach to the findings that have been analyzed from the research study (Flick et al., 2012). For this research, two forms of data were collected and analyzed where the qualitative data provide greater meaning to what was analyzed in the quantitative strand. Data that were analyzed also indicated amalgamation of some aspects of both theories that were used in the research. The semi-structured interviews in the needs assessment provided greater understanding when the PBL checklist and field notes data were collected and analyzed. This was also seen in the action research cycle that once there was a change in the data for the PBL checklist that was quantitative in nature, there was corroboration in the qualitative data when the field notes, teachers’ and researcher’s journals
were analyzed. Merging the two forms of data provided a more complete and in-depth picture of the sustained professional development that was done. It also provided the researcher with information of how well the professional development was accepted and if the participants were transformed. The merged results are presented under the main headings for the research.

**Needs Assessment**

The results from the problem-based learning checklist revealed that teachers did not enact PBL in their classrooms even after they attended problem-based learning workshops. The quantitative data also indicated that lessons were teacher-driven and not student-centered as depicted by the PBL theory. The finding was reaffirmed by the qualitative data as teachers shared their perceptions about the enactment of PBL in science classes. The semi-structured interview data revealed that even though teachers were previously trained or informed about the instructional strategy, it was never implemented in the classroom. In addition, data from the interview indicated that teachers expressed their lack of the required skills, knowledge and competencies for enacting instructional strategies that were taught in workshop sessions into their classrooms. Furthermore, the data revealed that teachers were new to the school and did not attend any workshops relating to PBL strategies and its benefits in the classroom. However, data showed that teachers attended professional development workshops in the past, and were asked to implement what was taught but some instructional strategies were never attempted, due to the lack of support to do that successfully. Teachers indicated that they were also not exposed to sustained professional development through coaching.
**Action Research Cycle**

The qualitative and quantitative data showed the correlation between professional development that was framed using transformative learning theory, which created change among teachers as well as the researcher’s own praxis. The quantitative data indicated that the required competencies and best practice for problem-based learning were not evident in the needs assessment stage but they were demonstrated during the action research cycle. The researcher gained deeper meaning from the teachers’ reflections, as they further explained the lack of PBL requirements and best practices in the classroom. Data from the field notes for both Iterations 2 and 3 corroborated with the findings of the PBL checklist that found that the main PBL strategies were evident after problem-based learning was enacted using coaching techniques. The PBL checklist also indicated that collaboration was done after the sustained professional development was introduced. Teachers indicated that collaboration was helpful as co-planning was done for topic selection and lesson planning. In addition, collaboration was evident when modeling of activities and development of resources were done before they were implemented in classes.

The researcher utilized transformative learning theory as proposed by Mezirow et al., (2009) to assess the results for teacher transformation. Quantitative analysis revealed that reflection in the form of student evaluation was an important element for student-centered learning and problem-based learning strategies. The teachers’ reflection data revealed that after teachers practiced reflection as part of the coaching exercise it was easier to encourage students’ self-evaluations/reflection.

The qualitative data corroborated the fact that since the teachers were being taught through the coaching cycle about the instructional strategy and guided in the enactment stage that PBL best practices were seen in the classroom. This was seen when the PBL checklist was
done in both iterations. The qualitative data indicated that teachers recognized the importance of collaboration of staff and students when implementing PBL in classes. In addition, the data indicated the need for support and collaboration for teachers when a new strategy is implemented in the classroom. These data points confirmed the transformative learning theory, which indicates the importance of collaboration that creates teacher support. This paves the way for the formation of authentic relationships, improvement of dialogue, and in turn, critical reflection is done which are pillars for change.
CHAPTER V: CONCLUSIONS

Summary of the Study

Teachers’ professional learning has been a topic of interest in the education field for many years as different strategies and interventions are reviewed to improve and support high-quality learning of staff (Darling-Hammond et al., 2017). In addition, the writers explicate that professional learning for teachers is important as a main vehicle in supporting the numerous skills that students need to learn in preparation as 21st century workers (Darling-Hammond et al., 2017). Teachers in this research also indicated the need to prepare students with the needed skills for the 21st century but lack the “know-how.” The findings of this research confirmed the earlier research findings that indicate that significant change in practice can be seen when professional development is embedded in the context of the teacher’s practice (Darling-Hammond et al., 2017; Fullan, 2015). It is with this focus on the improvement of professional development for teachers that the researcher examined the impact of professional development using coaching for the enactment of problem-based learning strategies in science classrooms. Through pilot study and observation, it was noted that teaching strategies have been taught in workshop settings but was not enacted the classrooms. Earlier research indicates that instructional coaching promotes greater collaboration and reflection amongst teachers as learning is transferred to the classroom (Anderson et al., 2014; Showers & Joyce, 1996).

The results of this research study described the experiences of teacher-participants before the intervention was conducted and the findings after sustained professional development using coaching was done. The instructional strategy that was enacted using coaching was problem-based learning. The study was guided by two main theoretical frameworks, transformative learning theory (TLT) and problem-based learning theory (PBL). Transformative learning
theory (TLT) guided the interactions and professional development for the teachers. The main constructs included individual learning, critical reflection, authentic relationship, dialogue, awareness of context, and holistic orientation (Mezirow et al., 2009). This chapter includes the results and interpretation of the data, and how the findings were related to the theoretical frameworks that were used for the research study. In addition, the chapter outlines the discussion of findings, discussion of merged data recommendations for future research and practice, implications that may be applied to practices of teachers, administrators, and other stakeholders in the education field.

The main goal of this action research study was to examine the effects of professional development in science when coaching is used. Another purpose was to investigate if sustained professional development using coaching would potentially lead to the transformation of teachers’ instructional practice. The instructional strategy that was used for the professional development intervention is problem-based learning.

The research questions that framed the study were:

1) PD through the coaching model transfers to teachers’ instructional praxis.
2) Elements of PBL implementation will increase as a result of the intervention of the coaching model.
3) What are teachers’ perceptions about PBL implementation and the coaching model?
4) How does the research study improve the teacher-researcher’s research and praxis?

**Discussion of the Results**

This section will comprise a separate discussion of the qualitative and quantitative results followed by discussion of inferences (Teddlie & Tashakkori, 2009). The merged results will be presented using the two main theoretical frameworks used to guide this research study.
Quantitative Results

The quantitative results in this study were utilized to gather data in relation to the enactment of problem-based learning strategies in the classroom. The PBL checklist was utilized for classroom observations in the needs assessment stage as well as in the action research cycle, Iterations 1 and 2. Problem-based learning has been used in science classrooms and has proven to positively influence students’ critical-thinking, learning and involvement in classes (Carriger, 2015; Delisle, 1997; Servant-Miklos, 2018). The findings of this research was consistent with the research which was evident when PBL was introduced in classrooms students became more involved, enthusiastic and displayed critical-thinking skills in the lessons in Iterations 1, 2 and 3 when compared to the findings from the needs assessment. The findings also indicated that PBL best practices were evident in the classes and that changed the classroom from teacher-driven to one that was student-centered. According to McCormick Peterman (2012), in a PBL classroom, students take ownership of their learning and they are given the responsibility to find solutions to the problem given. The results indicated that students were active participants in the PBL classroom while the teachers facilitated learning.

The findings indicated that from the six general required competencies enlisted on the quantitative instrument, less than 50% was evident in the needs assessment. When data were compared to findings in Iterations 2 and 3, PBL best practices seen in classrooms was over 80% for all teachers. Delisle (1997) indicates that the presence of more of these PBL best practices in the classroom, there will be more promotion of students at higher levels of engagement in learning. This was evident from the data that was collected. Finally, the quantitative data indicated that teachers were able to transform their teaching practice from direct instruction to a student-centered approach using PBL strategies. This was successful through sustained
professional development between teachers and the researcher. The qualitative data added breadth and context to this data as teachers expressed their perceptions and shared what they experienced through the process of coaching that assisted them in the successful enactment of the new teaching strategy.

**Qualitative Results**

Overall results showed that teachers were enthusiastic to learn and enact new instructional strategies in their classrooms when there is support and guidance. The results showed that, while attending PD workshops might be informative and serve as an “eye-opener,” teachers do not transfer the skills learned to the classroom. This concurs with the literature that active learning amongst teachers provide deeply embedded professional learning that is highly contextualized (Darling-Hammond et al., 2017; Fullan, 2015). The findings of the research indicated that support and guidance was a major theme from the qualitative data. In the needs assessment stage of the research, teachers expressed the lack of guidance required for them to transfer skills from workshops to their classroom. However, this theme took on a different meaning during the action research cycle as teachers became enthusiastic to implement the PBL strategies in classes when they received support and guidance through coaching. This finding supports the literature which indicates that coaching is used to provide guidance and support for transferring learning from workshop sessions to more concrete applications that are integral to the classroom and students' growth (Brown, 2016; Joyce & Showers, 2002).

In addition, the findings indicate that teachers expressed the need for teacher collaboration and dialogue that could improve instructional practice. Teachers believed that they learned better from a colleague who they can go to for further clarification on a topic when compared to administration. Showers (1994) confirms that teachers should coach each other as
this gives them access to each other, build their repertoire and a willingness to persist and refine skills that are transferred to the classroom. Other research explicates that collaborative work can create communities that positively changes the culture of a school, department or district (Darling-Hammond et al., 2017; Guskey, 2002). Through the coaching process, teachers again indicated how much they as well as students have learned in a short time for the implementation of one instructional strategy.

Authentic relationship, a key construct in transformative learning theory (Mezirow et al., 2009) was a major theme that was seen in Iteration 3. Participants expressed that relationship building was recognized during this process. Teachers explained that they felt closer to the teacher-participants and the researcher through this process. Furthermore, the change of strategy in the classroom also allowed them to form strong bonds with their students. The literature confirms what the literature explains that coaching establishes foundational relationships that strengthen during the process as trust is built (Brown, 2016; Little, 1982; Showers, 1994).

Due to the nature of the professional development and the impact on teacher-participants, the findings indicate that there was a change in culture. This was seen from the quantitative data when classes were observed. In addition, it was further explained in the teachers’ reflections and post interview. This change in culture was seen in the classroom as students became more active, interested and involved in their learning. This finding has been confirmed in research that coaching can change the culture of a school, department, district or classroom. On the other hand, the culture of the school can also dictate the success of coaching (Robbins, 2015). The teachers explicated that this process have changed the culture and interactions amongst the small group of participants and they hope that coaching can be implemented in the school it is their belief that would create a change in the school’s culture.
Discussion of Merged Results

In general, the six core elements that were outlined in the transformation learning theory (TLT, Mezirow et al., 2009) were strongly supported by the results of this study. In addition, the constructs that are outlined in problem-based learning theory were also observed. This section will briefly explain how the merged results are related to the main theories that were used.

Transformative Learning Theory’s foundation is built on acknowledging and reviewing one’s individual experience as stated by (Mezirow et al., 2009). Indications showed that teachers did not have prior knowledge of PBL or peer coaching before the research study began. This was observed from the classroom visits, which produced the quantitative data. This was further substantiated from the interviews that were conducted. This data guided the path for transformative learning and all teachers were then trained and participated in numerous coaching sessions. The qualitative data showed that a lack of prior knowledge and guidance prevented the implementation of the instructional strategy in classrooms. Teachers explained that they were never aware that so much work could be covered in such short time in their classes. In addition, the integration of multiple subject disciplines was also informative for them. Implementing the instructional strategy through coaching promoted superb dialogue amongst staff and the researcher, which promoted critical reflection about the enactment of the strategy. Through critical reflection, teachers expressed that they were compelled to look at the content, process and their perceptions as proposed by Mezirow et al. (2009). Teachers expressed that because the researcher was in the classes and worked closely with them they has the opportunity to review some assumptions and beliefs that they had so greater success could be experienced. Teachers explained that because they had another perspective on what they were doing they could make
adjustments and improve the lesson as they reflected on previous lessons and activities in collaboration with their coach.

An awareness of context fosters transformative learning because there is an appreciation, understanding of personal, and socio-cultural factors (Mezirow et al., 2009). It is through awareness that teachers expressed their willingness to be trained and coached as they implemented PBL. In addition, the findings from the quantitative and qualitative data in the needs assessment led to the training of staff. Through training and coaching, the findings revealed that the knowledge of PBL and its possible benefits in the classroom generated much interest among the participants.

Relationship building was always encouraged at the school that the research was conducted. However, building of relationships takes time and should be purposeful as expressed by the teachers. Teachers expressed that relationship building was sometimes a challenge in one way or another. The qualitative data such as the post interviews and teacher reflections indicate that the teachers valued the relationships that were built during the coaching process. In addition, they were amazed how quickly these relationships were developed over the months through the teacher collaboration and coaching. Teachers indicated that relationships were built through interactions that were more genuine, purposeful and meaningful. This process allowed them to engage in open-discussions about what was happening in their classrooms, how they were feeling about the PD initiative and ways to achieve mutual and consensual understanding. These findings were consistent with transformative learning theory that was introduced by Mezirow et al. (2009). Finally, through comparison of the quantitative data as it reviewed the activities of the classroom relating to the PBL theory, the qualitative data also deepened the understanding of the transformation that was made for teachers. This transformation was the shift from teacher-
directed lessons to student-centered lesson where the teacher facilitated learning and balanced the power with shared decision-making and evaluation (Delisle, 1997; Mezirow et al., 2009).

Conclusions

The present research study provides empirical data that supports Mezirow’s (2009) transformation learning theory that examines the main elements for which adult transformation can be assessed. In addition, it provides evidence that supports the need for embedded professional development for educators and the benefits of coaching as the approach. The study supports the PBL theory in that the main tenets were visible from the classroom visits that were done. The problem-based learning checklist outlined the required competencies and best practices that should be evident in a PBL lesson. This instrument was used for the needs assessment and action research cycle, Iterations 1, 2 and 3. This would help to determine if the enactment of PBL lesson was successfully done. The qualitative data were collected from pre- and post-interviews, secondary sources, teacher reflections, field notes/memos and researcher’s reflection journal. The collection of this type of data provides thick rich data, which added to the depth of the findings from the quantitative data. The action research study allowed for the mixed method approach that utilized both quantitative and qualitative research questions, data collection and analysis procedures which corroborated the integration of meta-inferences (Teddle & Tashakkori, 2009).

The research study revealed that the enactment of PBL strategy in the classroom was a dynamic instructional strategy that was used to convert the teacher-led classroom to student-led. In addition, the instructional strategy revealed that once a problem-based learning lesson is properly planned it facilitates the integration of multiple subjects that allowed students to see the incorporation of different fields of study in solving a real life problem (Delisle, 1997).
Furthermore, benefits of the use of problem-based learning strategies that are outlined in Chapter II of this study were seen in the classes as the instructional strategy was implemented.

School administrators are faced with the daunting task of planning professional development interventions for staff. Very often, these are done in the form of workshop sessions and then teachers are asked to implement them in their practice. The results of the needs assessment indicated that while teachers are taught different strategies in a workshop setting, this does not negate the fact that there needs to be more support and guidance for successful implementation in the classroom. The findings of this study were strengthened through earlier research by Fullan (2015), indicating that embedded professional development facilitates more professional growth of teachers, teacher collaboration and improved students’ learning. This research study facilitated sustained professional development that was embedded over four months which showed major differences between collaboration of teachers, teachers transformation and improved students interest and learning.

The study showed that teachers were willing to participate in coaching activities to implement the PBL instructional strategy that would be beneficial to them as well as students’ learning. In addition, teachers recognized the power of teacher collaboration for different activities and the positive effects that this had on classroom activities. Teachers showed enthusiasm and gratitude for the support and guidance using coaching practices from the awareness stage to co-planning, modelling, implementation and reflection. Teachers built a level of trust during the coaching process as they expressed that they were comfortable with the coach; the intervention was confidential, non-evaluative and improved their professional practice.

Another key finding that was observed from the research study showed that all core elements of the transformative learning theory were seen from the data. Teachers’ individual
experience was analyzed when the pre-interviews were conducted and this was corroborated with the quantitative data from the needs assessment. As teachers acknowledged their need for support and guidance, the researcher facilitated the training of PBL and awareness coaching session. This led to much critical reflection of teachers as they reflected on their present practice, and how it could be improved to enable greater student learning and growth. Teachers engaged in dialogue with self and others as proposed by Mezirow et al. (2009) as they question key tenets of the instructional strategy that was implemented. Furthermore, through these dialogues, teachers collaborated with each other and the coach to problem-solve situations that arose during the coaching cycle.

As teachers became aware of their context through collaboration, reflection and dialogue, they developed a deeper appreciation for each other and used that as foundation to learning new areas and improving their professional practice. As the core elements were displayed during the process, teachers also acknowledged that this embedded professional development has allowed them to feel more connected to each other and relationships have been built and improved as they worked as a team to implement PBL in their classrooms. This sustained professional development enabled the process of transformation for teachers’ professional practice and a change in the classroom delivery, which influenced the culture.

Implications of the Study

High impact professional development should be used in schools to effect change (Reeves, 2010). According to Darling-Hammond et al. (2017), effective professional development should be sustained which will allow educators time to learn, practice, and reflect on what was learned. This research study has produced several implications regarding
professional development at this school, this organization’s group of schools as well as for building principals who might have access to this research study.

To improve and increase teachers’ learning and enactment of instructional strategies in the classroom, administrators should work together in creating strategic plans and effective systems for the planning and execution of teachers’ professional learning. These plans should seek to fill the pedagogical gaps, introduce staff to innovative technology, and research data of effective strategies to be used in the teaching and learning environment. If these steps were taken it would minimize the occurrence of teachers attending a “one size fit all” workshop. First-year teachers should attend professional development sessions that are relevant to them. On the other hand, teachers who have taught for several years should attend professional development interventions that would work at closing the gaps in their practice /profession.

Another implication of the study is that administrators should seek to provide more guidance and support through sustained coaching for staff when new teaching strategies are introduced. When teacher evaluation visits are only done and there is little to no teacher supervision, it defeats the purpose of improving teacher effectiveness. Darling-Hammond (2010) indicates that a small percentage of teachers receive continuous professional development, coaching, mentoring, or peer observations that are directly related to the administrator’s visits in the classroom. It was evident that teachers are open to receiving support and guidance through coaching to improve their practice. Teachers are also willing to participate in co-planning and all the tenets of coaching for the implementation of classroom strategies instead of being given a lesson by someone for execution.

Findings from this study indicate a need for administrators to encourage a culture of teacher -collaboration and professional learning community. Teachers indicated that they learned
better from their colleagues who have implemented different strategies in their classrooms so they can question them or see it directly when they visit the classroom. In addition, the teachers indicated that teacher collaboration would strengthen relationships and change the culture of the school hence more focus would be on student learning.

**Limitations**

The primary limitation was the small convenience sample of four teacher-participants in one school in Southern Connecticut in the United States. Although the findings from this study could not be generalized to a larger population, many teachers have similar experiences where professional development workshops are held but the enactment of the strategy is a challenge. Researcher bias could also be a limitation to this study but validity measures including data triangulation and member checks were done to reduced potential interpretation bias.

Iterations 1 and 2 were done following each other because of the time constraints for the schedule and activities that the school had instituted from September. Public schools are required to conduct scheduled testing within a given, “testing window,” this meant that the research study had to be done before the second set of testing by the March-April 2020. Students were scheduled to start their practice SBAC and NGSS testing in March so this time constraint was also a limitation. There was an early closure of school before the Spring Break because of the COVID–19 virus. All schools in the district were asked to close until further information from the Department of Education. As a result, the participants of mathematics were not able to complete their final lesson of oral presentations from the students. The teacher-researcher however, worked with these participants online for the completion of their reflections to the point that they were before the closure of the school.
Initially, when Iteration 3 began, the science participants felt a little less supported because two other participants had joined the team for enacting problem-based learning in their classroom. The teacher-researcher had to complete training, planning, and then coaching for all teachers because three of the four teachers had never attended a workshop about problem-based learning. The mathematics participants did not know about problem-based learning and could not differentiate the teaching strategy from teaching using worded problems. As a result, the teacher-researcher had to train, co-plan with individual teachers because they had different topics, guided the process systematically by modeling, as well as help to plan and coordinate the use of lab spaces. What it meant was that the teacher-participants that completed Iteration 2 and moved on to Iteration 3 had less meeting time as a group but they quickly recognized that the approach for coaching was a little different as in Iteration 2 but coaching was still evident to provide the support and guidance for continued enactment of the instructional strategy.

**Ethnographic Reflection**

Data analysis was done at all stages during the research study, which included the needs assessment and action research cycle. In the action research cycle for Iteration 1, qualitative data from teachers’ and researcher’s reflection journals were collected and analyzed. During iterations 2 and 3, qualitative and quantitative data were collected and analyzed. The researcher sought to gather thick, rich data in an effort to establish legitimacy and reliability (Creswell & Plano Clark, 2011). In addition, the data that were collected assisted the researcher to greater comprehend the depth of the phenomenon that was examined. Data that were collected were from teachers’ reflection journals, field notes/memos, researcher’s reflection, secondary sources, pre- and post-interviews and problem-based learning observation checklist. At the end of the needs assessment, the researcher coded, refined, and analyzed the data to identify emergent themes. In addition, the
researcher reflected on data received from the quantitative data and reviewed these with the
qualitative data to garner a deeper understanding which informed the activities of the
intervention. The emergent themes of the qualitative data from Iterations 1 and 2 guided the
activities for adjustments at each follow-up iteration. The emergent themes also provided a way
for the researcher to examine if teachers’ instructional practice has been changed; this was done
using the transformative learning theory. The main goal of the research study was using peer
coaching as the professional development initiative to enact a new instructional activity and
examine if this PD would transform teachers’ praxis.

As indicated from the data, teachers believe that professional development is great to give
much needed information about improvement of teachers’ practice but there was a need for
support and guidance to enact what is learned in a workshop setting into the classroom.
Sustained professional development has also been encouraged by researchers as this has proven
to be effective in the education field to improve students’ learning (Guskey, 2000; Diaz-
Maggioli, 2004). Furthermore, Showers and Joyce (2002) explain that peer coaching is an
initiative that is designed to provide guidance and support to enable teachers to refine their
pedagogical skills. Information from the needs assessment shaped how this support and guidance
would take and provide the teachers with the needed support for the enactment of the problem-
based learning strategy. At the heart of the success of this research study was the willingness of
the teachers to be vulnerable as they accepted the guidance and support needed to transfer
knowledge gained in the traditional workshop setting to the classroom hence transformation of
their practices. The teachers indicated that collaborative work between teachers and students,
teachers and teachers and teachers and researchers had improved the activities of the classroom.
The level of collaboration during the action research cycle created support and guidance needed
by the teachers as they engaged in dialogue and ultimately critical reflection was done, which formed the basis for changes during each stage. This research study has positively affected the teaching praxis of the researcher, as learning was two-fold from teacher to researcher and researcher to teacher. The reflection journal of the researcher acknowledge that trust was built through collaboration over an extended period which formed the basis for change in culture between the teacher-participants classrooms and as colleagues working together.

**Recommendations for Future Research**

It is imperative to know what systems are used by school administrators for the creation of professional development/interventions for a school year and what strategies are in place to measure the success of these interventions concerning teachers' and students’ learning. Future research could look at another round of interviews with administrators to see what systems are in place, how teachers can effectively benefit from planned interventions. Administrators would be trained by the researcher in different strategies for sustained professional development; this would include coaching. When this is done, then one iteration could be done with administrators providing support for coaching by providing a set of teachers over a period to become peer-coaches and the relevant data collected and analyzed. During the interviews, teachers expressed their concerns about the lack of guidance and support for the enactment of new teaching strategies. Hence, the administrators could provide greater support for peer coaching where one group would provide coaching and then those teachers after being coached will provide coaching for a new set of teachers. This will then be evaluated to see the impact that it makes on the teaching and learning environment.

Additional research could be done to utilize sustained professional development through formal coaching with a larger sample in one school. This research could include having more
teachers from different subject areas and assess the influence that this collaboration and coaching might have on students’ learning and school culture. This research study could also include the evaluation of the students’ learning while sustained professional development is conducted among these teachers. In addition, future researchers could examine after the professional development takes place what is the period of time that these changes are sustained by the teachers.

Finally, there is a need for future research amongst more schools in the district or group of schools to look at the effects that peer coaching may have on administrators, teachers, and students. What this research would do is look at professional development using a tri-fold approach. Administrators would be involved in the intervention for formal coaching and then apply those skills to different schools and classrooms. This would include the administrators who participate in the research study, coaching teachers in their buildings, or the selected locations/cluster. The teachers who are coached will then formally measure to see what effects the coaching practice and enactment have on students’ learning. Taking different steps, researchers can evaluate in a general way to confirm or disconfirm if sustained professional development using coaching fosters meaningful professional growth for staff. Also, it transforms problematic frames of reference to make it more inclusive to promote change in the classroom (Mezirow et al, 2009). This will facilitate the creation of high-quality learning experiences for staff and students so that every student succeeds (Robbins, 2015).

Summary

This action research study utilized a mixed approach where qualitative and quantitative data were collected and analyzed throughout the process. The study sought to examine if professional development in science, using coaching, can transform teachers instructional
practice. The research study used sustained professional development to enact problem-based learning theory in science classes and math to assess its success and potential for change amongst teachers. The use of PBL and TLT theories framed the research and provided a frame of reference for the researcher’s evaluation of findings. The findings revealed that teachers are enthusiastic to enact new instructional strategies in the classroom that will enhance students learning as well as provide pedagogical skills that needed to prepare 21st century workers. However, the results from the data indicated that teachers need more support, guidance, and collaboration to make a shift from information giving as experienced in workshop settings to how this is accurately implemented in the classroom. In addition, the findings revealed that sustained professional development such as coaching helps teachers to be confident, building an authentic relationship, utilize collaboration as they explore new instructional strategies that change the culture of the classroom that proved to be beneficial for students and teachers alike.
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ASCD.


# APPENDIX A

## Problem- Based Learning Lesson Plan Template

### Lesson Background

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<td>Common Core Standards/NGSS Standards:</td>
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<td>NGSS</td>
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<td>Student Role:</td>
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<td>Objectives:</td>
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<td>Timeframe:</td>
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<tr>
<td>Problem - In the form of a Question:</td>
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<tr>
<td>Misconception/s to be addressed in this lesson:</td>
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<tr>
<td>Safety concerns for this lesson:</td>
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### Activities

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<td>Guiding Questions</td>
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<td>Plan</td>
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<td>Differentiation</td>
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<td>ELL Modification</td>
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<td>Checking for understanding /Assessment</td>
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<td>Vocabulary - Teacher’s Guide</td>
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Adapted: Virginia Initiative for science teaching and achievement (2014)
## APPENDIX B

### Researcher’s Worldview Matrix

<table>
<thead>
<tr>
<th>Worldview Matrix</th>
<th>Constructivism</th>
<th>Post Positivism</th>
<th>Pragmatism</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Epistemology:</strong></td>
<td>Closeness: Researcher and participating teachers worked together for 4 months. Researcher and participants co-constructed knowledge through the use of interpretation of interviews. This will facilitate greater understanding of the local conditions. In addition through field notes, teachers’ reflection journals and review of secondary data. Interpretations were formed to examine what were the perceptions of teachers about PD and coaching. In addition, examining the needs of the local conditions.</td>
<td>Knowledge was constructed by proving PBL theory. PBL checklist was used for all class observations. The researcher, and participating teachers were interactively linked to acquire knowledge on the about PBL enactment using coaching. Knowledge gained influenced the researcher’s and teachers’ thoughts and praxis in relation to the use of coaching and how it aided in PBL enactment in classes.</td>
<td>Etic and Emic during the needs assessment and action research cycle. Knowledge is created through doing. Triangulation of data strands in action research cycle and needs assessment to validate information and provide a more detailed and descriptive understanding of what would transform teachers’ instructional practice in science and math. Participants will construct knowledge independently during critical reflection in the action research cycle.</td>
</tr>
<tr>
<td><strong>Axiology:</strong></td>
<td>The researcher made transparent any potential bias concerning the topic and position in the setting of the research. Researcher and participating teachers recognized their biases and negotiated their shared understanding and views about the value of the research process and its implications.</td>
<td>Researcher remained objective and maintained an etic view, despite being a teacher or colleague at the site. Interviews, journals, class observation notes and PBL checklist data were anonymous to eliminate bias.</td>
<td>Researcher took on an emic and etic stance to improve the local conditions at the school. Data gained from the needs assessment help to guide the planning and execution of the action research cycle for example Iteration 1: Intervention. Emic:- coding of interviews, field notes. Secondary sources, journal notes Etic:- PBL observation checklist During the process of the intervention, the researcher was cognizant of my role as a coach and be constantly aware and understand my bias as a science teacher and colleagues of the teachers.</td>
</tr>
<tr>
<td>Methodology: How the processes of research are used</td>
<td>Qualitative Methods: Participating teachers of science and math were involved in an inductive approach where emergent ideas through the use of semi-structured interviews were transcribed and coded using emergent themes. Exploration of needs analysis of professional development and coaching also how these influence the enactment of PBL in classrooms. Dialogic and dialectical approach. This included the researcher, and participating teachers.</td>
<td>Quantitative Methods: Needs assessment and action research cycle – use of PBL observation checklist. Data from descriptive analysis of the needs assessment informed the Iteration 1. Data from Iteration 1 informed Iterations 2 and 3. This evaluated the evidence of the PBL required competencies and elements in science and math classes.</td>
<td>Multiple forms of data and approach to understand the best solutions to the phenomenon. Needs assessment: exploration of the needs in the local setting. Action research cycle: using field notes, reflection journals, lesson plans, interviews used as measures to assess if coaching influenced the enactment of PBL strategies in classes and if there was a transformation of teachers and researcher’s praxis. Multiple forms of data were analyzed from Secondary sources- charter/policy, lesson plans, curricula for science and math for Grades 7-10. PBL checklist, field notes, participants’ reflection journal, researcher’s journal, pre and post semi-structured interviews. secondary source PISA survey in order to understand the data.</td>
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<tr>
<td>Ontology: Reality of what exists</td>
<td>Each participant created their own reality through knowledge that was created and gained through experiences and interaction with the world.</td>
<td>Truth and reality can be best defined through scientific means and empirical data.</td>
<td>Each participant’s perspective was shaped by their experience, knowledge and actions. This is known as a “theory of knowing.”</td>
</tr>
</tbody>
</table>

*Researcher’s Worldview Matrix (Christ, 2013)*
## APPENDIX C

Pre-Interview (Semi-Structured)

<table>
<thead>
<tr>
<th>Question 1: What are your thoughts about professional development?</th>
<th>Interviewees Responses</th>
<th>Researcher’s Notes</th>
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<th>Probing Question:</th>
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<thead>
<tr>
<th>Question 2: What does professional development mean to you?</th>
<th>Interviewees Responses</th>
<th>Researcher’s Notes</th>
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<tr>
<th>Question 3: How does a PD workshop help in your implementation of new strategies</th>
<th>Interviewees Responses</th>
<th>Researcher’s Notes</th>
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<thead>
<tr>
<th>Question 4: What does sustained professional development mean to you?</th>
<th>Interviewees Responses</th>
<th>Researcher’s Notes</th>
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<tr>
<th>Question 5: Describe the staff development model in your school?</th>
<th>Interviewees Responses</th>
<th>Researcher’s Notes</th>
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<tr>
<th>Question 6: Describe what are your thoughts about Coaching?</th>
<th>Interviewees Responses</th>
<th>Researcher’s Notes</th>
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<tr>
<th>Question 7: What does leadership mean in your school?</th>
<th>Interviewees Responses</th>
<th>Researcher’s Notes</th>
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<thead>
<tr>
<th>Question 8: What do you understand problem-based learning to mean?</th>
<th>Interviewees Responses</th>
<th>Researcher’s Notes</th>
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<tr>
<th>Question 9: What are your general thoughts about PBL?</th>
<th>Interviewees Responses</th>
<th>Researcher’s Notes</th>
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<th>Probing Question:</th>
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<table>
<thead>
<tr>
<th>Question 10: What do you think about the use of PBL in secondary science classrooms?</th>
<th>Interviewees Responses</th>
<th>Researcher’s Notes</th>
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<th>Probing Question:</th>
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<table>
<thead>
<tr>
<th>Question 11: What would be necessary/needed for you to implement PBL in your science classroom?</th>
<th>Interviewees Responses</th>
<th>Researcher’s Notes</th>
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<th>Probing Question:</th>
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<table>
<thead>
<tr>
<th>Question 12: How do you see PBL impacting your science classes if implemented?</th>
<th>Interviewees Responses</th>
<th>Researcher’s Notes</th>
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</thead>
<tbody>
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</table>

<table>
<thead>
<tr>
<th>Question 13: Is there any other information you would like to add?</th>
<th>Interviewees Responses</th>
<th>Researcher’s Notes</th>
</tr>
</thead>
<tbody>
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</table>

## Additional Notes/Comments:
APPENDIX D

Post- Interview (Semi- Structured)

<table>
<thead>
<tr>
<th>Date of Interview:</th>
<th>Interviewee Responses</th>
<th>Researcher’s Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time of Interview:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interviewee (Pseudonym):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Role of Interviewee:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 1: What are your general thoughts now about professional development?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probing Question:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 2: What was your most outstanding/rewarding experience while you implemented PBL in your classroom?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 3: What are your thoughts about the use of PBL in math or science classrooms?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 4: Describe how problem-based learning affected the activities of your classroom?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 5: What are your thoughts about coaching as a professional development initiative?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 6: How did coaching as a Professional development initiative helped with the implementation of PBL in the classroom?</td>
<td></td>
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</tr>
<tr>
<td>Question 7: What are your most outstanding or rewarding experience gained through this coaching experience</td>
<td></td>
<td></td>
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<tr>
<td>Probe: How did you benefit from the experience?</td>
<td></td>
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</tr>
<tr>
<td>Question 8: Describe any major challenges that were experienced during the coaching process?</td>
<td></td>
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</tr>
<tr>
<td>Question 9: How do you see coaching as a professional development initiative influencing the staff model at this school?</td>
<td></td>
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</tr>
<tr>
<td>Question 10: Describe the professional development experience during this research.</td>
<td></td>
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</table>
### APPENDIX E

Data Analysis Comparison Matrix

<table>
<thead>
<tr>
<th>Needs Assessment</th>
<th>Qualitative</th>
<th>Quantitative</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Action Research Cycle</td>
<td>Qualitative</td>
<td>Quantitative</td>
<td>Findings</td>
</tr>
<tr>
<td>Iteration 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iteration 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iteration 3</td>
<td></td>
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</tbody>
</table>
APPENDIX F

PBL Checklist for Classroom Visits

<table>
<thead>
<tr>
<th>Required competencies</th>
<th>Best practices (measurable practices)</th>
<th>Check</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedagogical beliefs:</td>
<td>• Encourage students to bring their own solutions (ie, avoid giving direct answers)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>student-centred</td>
<td>• Form students into groups and assign different roles</td>
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</tr>
<tr>
<td>learning</td>
<td>• Spend a minimal amount of time delivering content knowledge to students</td>
<td></td>
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<tr>
<td></td>
<td>• Use open-ended questions instead of yes/no questions (using how, when, where, what if ...)</td>
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<tr>
<td></td>
<td>• Have students self-evaluate and reflect on the problem-solving process (journaling, self-checking rubrics, etc)</td>
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<tr>
<td></td>
<td>• Promote cooperation and teamwork (form students into groups and assign different roles)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology use for</td>
<td>• Integrate technology components in the process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>higher-order thinking</td>
<td>• Use computer tools to convert data (eg, figures, facts) to meaningful knowledge (eg, use the data for final presentation)</td>
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<tr>
<td></td>
<td>• Provide a set of advanced techniques for using software or hardware (ie, how to use Boolean functions for better online search results, how to insert multimedia components in PowerPoint)</td>
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<tr>
<td></td>
<td>• Provide support for higher-order thinking using technology (ie, provide criteria for evaluating websites)</td>
<td></td>
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<tr>
<td>Planning and</td>
<td>• Use ill-defined and real world problem as a driving question</td>
<td></td>
<td></td>
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<tr>
<td>organising</td>
<td>• Well-organised PBL stages (problem formation, data collection, brainstorming solution, evaluating and selecting solutions)</td>
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<tr>
<td></td>
<td>• Refer to information on Indiana academic standards when planning</td>
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<tr>
<td></td>
<td>• Prepare and arrange various resources to help students gather information (guest speakers, video tapes, and library resources)</td>
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<tr>
<td></td>
<td>• Prepare performance-based evaluation methods</td>
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<tr>
<td></td>
<td>• Have self-monitoring guidelines (ie, checking overall schedule frequently)</td>
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</tbody>
</table>
APPENDIX F (Continued)

**PBL Checklist**

<table>
<thead>
<tr>
<th>Required competencies</th>
<th>Best practices (measurable practices)</th>
<th>Check</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom management skills</td>
<td>• Monitor students progress frequently (Check each group’s work at least once a class time)</td>
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<tr>
<td></td>
<td>• Provide verbal and written feedback for student</td>
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<td></td>
<td>• Provide clear guideline and instruction (handout, TP materials, PPT)</td>
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<td></td>
<td>• Use various questioning skills (eg, ask what-if questions instead of yes/no question)</td>
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<td></td>
<td>• Specify group participation points, verbally emphasise frequently</td>
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<tr>
<td></td>
<td>• Use visual tools to help students break down abstract concepts to concrete sub-components (eg, concept maps)</td>
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<td></td>
<td>• Provide practical examples (eg, other students' previous work)</td>
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<tr>
<td></td>
<td>• Provide alternative solutions to immediate questions and problems during PBL process</td>
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<tr>
<td></td>
<td>• Challenge students’ data assumptions and sources (eg, Are you sure these are relevant, valid ... ?)</td>
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<tr>
<td>Collaboration</td>
<td>• Collaborate with other teachers (ie, team teaching)</td>
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<td></td>
<td>• Share PBL ideas and experiences with others (ie, attend dinner seminar)</td>
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<tr>
<td>Professional development</td>
<td>• Attend PBL and technology workshops</td>
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<td></td>
<td>• Register for graduate courses</td>
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doi:10.1111/j.1467-8535.2008.00858.x
## APPENDIX G

Instrument for Theory Comparison

<table>
<thead>
<tr>
<th>Themes (T LT Constructs)</th>
<th>Description</th>
<th>Examples from Scripts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical reflection (Content, process and premise)</td>
<td>Questioning of the integrity of deeply held assumptions and beliefs according to prior experience. This will be reviewed from the teacher’s point of view as well as how students in the classroom are guided to do this.</td>
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</tr>
<tr>
<td>Individual Experience</td>
<td>This describes what each learning brings, that is prior knowledge and what is experienced in the classroom.</td>
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</tr>
<tr>
<td>Dialogue</td>
<td>Engagement with self and others</td>
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<tr>
<td>Holistic Orientation</td>
<td>Engagement in other ways of knowing such as affective and relational.</td>
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</tr>
<tr>
<td>Awareness of Context</td>
<td>Deeper appreciation and understanding of personal and socio-cultural factors.</td>
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</tr>
<tr>
<td>Authentic Relationship</td>
<td>Establishment of genuine relationship with students. Positive and productive relationship.</td>
<td></td>
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<tr>
<td>Learner – centered teaching</td>
<td>Teacher acts as a facilitator of learning. Balancing of power with students – shared decision making, evaluation and other learning responsibilities.</td>
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</tbody>
</table>
### APPENDIX H

**PBL Observation Comparison Chart**

<table>
<thead>
<tr>
<th>PBL Constructs</th>
<th>Grade 7</th>
<th>Grade 8</th>
<th>Grade 9</th>
<th>Grade 10</th>
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May 28, 2019

RE: Dissertation Action Research Study

Dear [Name],

For a number of years I have worked as a science teacher and have been involved in professional development and leadership in schools. Since the past two years I have been working closely with the science team at the school and have been able to review different teaching strategies that are commonly used to teach science from Grades k-12. It is through this high level of collaboration with teachers that has encouraged and motivated me to assist my colleagues to enhance and add new methods of instructional strategies in science. It is my intention to create an intervention that will guide science teachers using professional development workshops and formal coaching over a period of time. During this time, the researcher will examine if teachers instructional practices are transformed after completing sustained professional development.

For my dissertation research, I would greatly appreciate your support in conducting an action research study that will examine the implementation of professional development in science using coaching. The professional development intervention will include conducting workshops with the participants. In addition, the peer coaching model will be utilized to select, plan and implement problem-based lessons in Grades 7 to 10. With this in mind, during the needs assessment, anonymous data will be collected by conducting semi-structured interviews with science and math teachers (N=4). This will allow the teacher-researcher to examine their perceptions about sustained professional development using coaching. In addition, direct observations of classes will be done for science classes. Where the teacher-researcher can capture data about the instructional strategies used in the classroom and how students learning in the science classrooms. Using the needs assessment data, it will allow the researcher to employ suitable professional development activities to include workshops and coaching for science teachers in Iterations 1 and 2. In Iteration 2, the math teachers will utilize the professional development packet and procedural steps to implement problem-based learning strategies in their classes (Grades 7 – 10). The researcher will visit the class and meetings where the relevant measurement tools will be utilized. For the professional development intervention, the researcher will train science teachers in the use of problem-based learning strategies and enactment will be done using the formal peer coaching model. Lesson plans will be assessed using the Marzano lesson plan rubric. Problem-based learning will be assessed using a PBL observation checklist and PBL peer observation protocol. Using the coaching model and the main tenets of transformative learning theory, the participants and researcher will continuously be engaged in critical reflection, dialogue, utilization of prior experience and through the use of the school and personal context.

To ensure that this research does not interfere with the school’s effort to educate students nor interfere with morale of the participants who are included, the data and findings will be confidential, and the identities of the participants will remain disclosed.

I am hoping you will grant me permission to support the school through this research study. For additional information, please refer to an overview of the study Participant Information Guidelines & Consent, attached.

Respectfully,
Sherlene C. E. Johnson
APPENDIX J

Participant Information Guidelines and Consent

<table>
<thead>
<tr>
<th>Title of research</th>
<th>Implementing Professional Development in Science using Coaching: An Action Research Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigator</td>
<td>Sherlene Johnson</td>
</tr>
<tr>
<td>Rationale</td>
<td>The action research study will examine the impact of the implementation of professional development in science using coaching. This will be done to determine if sustained professional development will transform teachers’ instructional practice which will eventually improve students learning. The exploratory needs assessment stage will be done when qualitative data will be collected to determine teachers’ perceptions about sustained professional development and its relationship to the teachers’ transformation of instructional practice. In addition, the participants will share their thoughts about the use of problem-based learning strategies in science/math classrooms. The action research cycle will include professional development intervention workshops and coaching will be used for planning, creation and enactment of PBL lessons over a period of time. Grades 7 – 10 teachers will be participants in the research study.</td>
</tr>
</tbody>
</table>

1. What you should know about this research study
   a. Someone will explain this research study to you
   b. You volunteer to be in the research study
   c. Whether or not you take part is up to you
   d. You can choose not to take part in the research study
   e. You can agree to take part now and later change your mind
   f. Whatever you decide will not be held against you
   g. Feel free to ask all the questions you want before you decide

2. Who can I talk to?
   If you have questions, concerns, or complaints, or think the research has hurt you, talk to the research investigator at (203) 919-6662 or shejohns@my.bridgeport.edu

3. Approval
   This research has been reviewed and approved by an Institutional Review Board. You may talk to the IRB Administrator at (203) 576-4937 or irb@bridgeport.edu or any of the following if:
   a. Your questions, concerns, or complaints are not being answered by the researcher
   b. You cannot reach the researcher
   c. You want to talk to someone other than the researcher
   d. You have questions about your rights as a research subject
   e. You want to get information or provide input about this research

4. What is the purpose of this research?
   The purpose of this action research study is twofold: First, to explore local conditions if professional development approach used at the school effectively helps teachers to implement new initiative learned. In addition to confirm if providing professional development using coaching will transform teachers’ instructional practice. Secondly the impact of problem-based learning strategies in science classrooms when sustained professional development is done.
5. **How long in duration is the research?**

The research will be conducted from June 2019, August 2019 to November 2019. If additional iterations or interventions are required, this timeframe may be extended.

6. **What data will be collected?**

Data will be collected from the following:

- a. Semi-structured interviews to be analyzed coding by themes.
- b. Direct observation of classes, analysis will be coding for themes
- c. Marzano lesson plan rubric (professional development intervention)
- d. Participant informal on-going reflective journal (at least one entry per week)
- e. Meetings to discuss challenges, progress and questions
- f. Secondary sources: existing teacher lesson plans, curricula, school charter
- g. Focus-group and individual meeting notes
- h. Researcher’s field notes to include reflections
- i. Problem- based learning behavioral checklist
- j. PBL Peer observation Protocol
- k. Implementation checklist for PBL lessons

7. **How many people will be studied?**

2 science teacher-participants in Iteration 1 and 5 participants in Iteration 2(2 science teachers and 2 math teachers)

8. **What happens if I say yes, I want to be in the research?**

*If you voluntarily agree to participate in this study, you will be asked to complete the following:*

- a. Facilitate classroom observation visits by the researcher before and during the research study.
- b. Semi-structured interview that will take approximately 30-45 minutes to complete, and a follow-up focus interview to discuss the overall findings of the interviews. Semi-structured interview will allow you the opportunity to elaborate and discuss your responses as much as you want to.
- c. Participate in professional development workshops
- d. Be involved in coaching activities
- e. Participate in professional development meetings to plan, implement PBL lessons that are done through collaboration.
- f. Participate in writing journal reflections using guidelines from the researcher
- g. During and following this process, your identity will not be disclosed. However, the teacher-researcher will be recording the interviews, group and individual meetings so that data can be transcribed. This will allow information in order to determine an insider and outsider perspective about the effects of sustained professional development.
- h. The findings from the study will be available to you during and when the research study is concluded. In addition, you will have access to your transcripts, codes and themes, and quantitative data from the PBL behavioral checklist, Marzano lesson plan rubric from Iterations 1 and 2.

9. **What happens if I say no, I do not want to be in this research?**

- a. You may decide to not participate in the research and it will not be held against you.
- b. Please not that your participation is strictly voluntary and you are free to withdraw at any time.

10. **What happens if I say yes, but I change my mind later?**

- a. You may agree to take part in the research and even begin, but your participation is strictly voluntary throughout and so you are free to withdraw at any time.
- b. If you begin the research and then decide to leave the research, there is no penalty
- c. If you decide to leave the research, contact the investigator so that the investigator at: 203-919-6662, shejohns@my.bridgeport.edu or sherlene.johnson@capitalprepharbor.org simply do not participate.
11. Is there any way being in this study could be bad for me?
   a. Your participation in this research will pose no risk
   b. Your involvement will cost you only minimal time
   c. No positive or negative implications can be derived that may have any bearing on your assignment status or status within the school; this researcher and researcher’s role is completely detached from all formal and informal evaluations.

12. Will being in this study help me in any way?
   a. We cannot promise any benefits to you or others from taking part in this research.
   b. Possible benefits may include understanding the benefits of sustained professional development through coaching. In addition, how this approach to PD transforms teachers instructional practice. Through sustained PD, problem-based learning lessons can be planned and enacted in classes.

13. What happens to the information collected?
   a. Efforts will be made to limit your personal information, including research study and interview data records, to people who have a need to review this information. We cannot promise complete secrecy.
   b. Organizations that may inspect and copy your information include the IRB and other representatives of this organization.
   c. All data from the interviews will be recorded on a digital voice recorder and stored electronically on a password and pin-protected laptop. The researcher will transpose the data into a Microsoft Word 2013 document in order to transcribe the interviews verbatim before coding and analyzing them for themes and later merging them into broad categories.
   d. All data from the interviews will be recorded on a digital voice recorder and stored electronically on a password/pin-protected laptop. The researcher will transpose the data using Microsoft Word document in order to transcribe the interviews verbatim before coding and analyzing constructs/themes.
   e. Categories will be further analyzed, compared and eventually reduced to main constructs. This will provide the basis for a narrative that summarizes the research findings.
   f. The qualitative data will be subjected to validity and reliability tests. The interviews will follow a specific pre-determined protocol and steps taken in interviews as well as the researcher’s thoughts and perspectives will be carefully documented. Following transcription and analysis, the interviewees will be given both the transcription and findings from the interviews to check for accurate representation of their thoughts (member checks).
   g. The interview data will be compared with observation data findings to understand teachers’ perceptions of professional development and their PBL knowledge, needs and resources that are necessary.
   h. Data will be stored on the researcher’s laptop which is password and pin protected. The transcripts will be printed and remain at the home of the researcher and stored in a private desk that is locked at all times. Following three years after the completion of the Ed. D program hard copy documents will be shredded.

Lesson plans, focus- group meeting notes, individual meeting notes/discussions, and reflective journals will remain confidential between the participants and researcher.
   i. All observations documents will be held confidential.

14. Can I be removed from the research without my permission?
   a. The person in charge of the research study or the sponsor can remove you from the research study without your approval.
   b. Possible reasons for removal include: Failing to respond to the questions appropriately and accurately; failure to attend the meetings and maintain the required documentation (reflective journals); failure to invest in seeking to increase an understanding of and a capacity to implement and improve instructional practice.
May 28, 2019

Dear Colleague:

As part of my doctoral studies at the University of Bridgeport under the direction and guidance of my Dissertation Chair, I will be conducting an action research study that will examine the impact of implementation of professional development in science using coaching. The purpose of this study is to explore the use of coaching as a sustained professional development approach to see if teachers’ instructional practice will be transformed. In addition, the planned intervention will utilize problem-based learning strategies for planning and enactment in science classrooms. This will allow science teachers to assess the impact that this may have on students’ understanding and achievement in science.

In Iteration 2, during the action research cycle of the dissertation, Math teachers will utilize all resources that are used for the professional development and coaching process to implement Problem-based learning lessons in their class. Through reflection and some form of coaching, teachers will assess if their instructional practice has been transformed. Data will be collected through semi-structured interviews at the needs assessment and at the end of the action research cycle. In addition, direct observation of classes, critical reflection and group meetings will also provide data for the research study.

It is the researcher’s hope that as a selected member of our profession and school, you will share your insight and help by participating in this action research study. The process will involve participation in sustained professional development through coaching. In addition, planning, development and implementation of problem-based lessons will be done using a collaborative effort. Please note that your participation is strictly voluntary. During and following this process, your identity will not be disclosed.

Should you need to contact me, my email is shejohns@my.bridgeport.edu or sherlene.johnson@capitalprepharbor.org. If you agree to participate, I thank you for offering your time and insights in advance.

Respectfully,

Sherlene Johnson
APPENDIX L
Model for Effective Professional Development and Coaching

1) Theory
The teacher must understand the research and rationale underlining the new instructional process or concept that is presented.

2) Demonstration
This process shows the teachers a model of what is being taught.

4) Coaching & Follow-up
Does observation, provides feedback and helps the teacher to internalize through reflection what is learned.

3) Practice & Feedback
Immediately in PD session an opportunity is given to practice what was modelled and immediate feedback is given.

APPENDIX M

Coaching Model for Professional Development

Awareness Session → Direct Instruction → Coaching “I do” Model → Coaching “We do” Supported Application → Coaching “You do” Application

Adapted: Robbins (2015, p.153)