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The Effects Of Subject Presentation Types In Problem Based Learning (PBL) Problems On Student Motivation: A Pbl Implementation In Speech Language Pathology

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THE EFFECTS OF SUBJECT PRESENTATION TYPES IN PROBLEM BASED LEARNING (PBL) PROBLEMS ON STUDENT MOTIVATION: A PBL IMPLEMENTATION IN SPEECH LANGUAGE PATHOLOGY

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This dissertation, submitted by Elaine Kim Pyle in partial fulfillment of the requirements for the Degree of Doctor of Philosophy from the University of North Dakota, has been read by the Faculty Advisory committee under who the work has been done and is hereby approved.

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Elaine Kim Pyle
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ABSTRACT

Problem-Based Learning (PBL) is an evidence-based instructional approach designed to maximize one's ability to use static knowledge as evidence for solving authentic problems (Barrows, 1986). Students have been observed as underprepared or skipping steps during the PBL process due to fatigue or low motivation (Czabanowska, Moust, Meijer, Schröder-Bäck, & Robertson, 2012). This study considered the impact of the presentation of the PBL subject (i.e., the key character involved in the problem) on student motivation within the context of Speech and Voice Science curricula. The results of this mixed-methods study showed the frequency of engagement behaviors declined overall. Although engagement levels declined and fatigue appeared to play a role, most students identified the final problems designed with a combination of higher social presence (i.e., audio-visual, face-to-face interaction) and challenging content as the most motivating. Students were able to develop a sense of ownership and responsibility for their problem-solving efforts, fostered by the direct interaction with the problem subject. This study also provides an example of a PBL implementation at the undergraduate level in Speech Language Pathology.

Keywords: problem-based learning, problem design, motivation, speech language pathology, speech and voice science.

CHAPTER I

INTRODUCTION

In a learner-centered paradigm of education (Huba & Freed, 2000), learning is an iterative process creating opportunities for students to understand concepts in a cooperative and supportive environment, ultimately leading to synthesis, critical thinking, and problem-solving. Selecting effective instructional strategies and designing learning activities that align with these principles is important, as instructional methods are purposefully chosen by instructors to meet specific student learning outcomes (Nilson, 2010). Although student learning outcomes describe the intended result of a learning method and become an assessment measure for courses, programs, and institutional effectiveness (Maki, 2010); learning outcomes also serve as a foundation and a guidepost for instructional design. It can be rather nebulous to isolate which specific factors of an instructional method are crucial for fully engaging students and understanding how individual students respond to a learning strategy given the diversity of learning environments, instructional methods, and adult learners in higher education.

In designing and conducting instructional activities, one must consider not only the efficacy of the instructional approach, but also how to adjust an approach to meet the needs of a population of learners who display a continuum of unique prior experiences, cognitive levels, and sociocultural factors. Problem solving, critical thinking, and reasoning skills are desired learning outcomes (Maki, 2010), because they function as a bridge between our ability to acquire content or domain knowledge, and our ability to apply the knowledge to real life and work-related experiences (Halpern, 1998). Ideally, our choice of instructional method should allow

mastery of learning goals, and provide students with the tools and motivation for engaging in the learning process so they may apply their knowledge for the challenges of their chosen vocations.

One may argue that an instructional method where students fail to successfully connect, and consistently engage and sustain motivation for effective solving of authentic problems is a failure in the overall, essential goal and purpose of education. For example, within the medical field, if a student can recite anatomical structures yet cannot use that information to help with their diagnostic decision-making process—an essential student learning outcome for competent medical practice—it represents a critical failure of the educative process, the successful application of knowledge in authentic situations. This unacceptable breakdown in the learning continuum is easily applied to other fields. The professional discipline of Speech Language Pathology (SLP), for example, requires deep content knowledge over a broad range of foundational knowledge domains, yet the daily practice of a SLP professional is not centered around the recall of discrete bits of information, rather it exemplifies the continual need to appreciate the complexity of an individual case, ask questions, and be motivated for ongoing problem solving for the assessment and treatment of a wide variety of multifaceted communication disorders. It is not surprising, therefore, that educators, instructional designers, and researchers continually seek to understand, use, refine, and optimize instructional methods in multiple disciplines and seek ways to sustain student motivation during learning. Their intention is to increase the likelihood of achieving our educational goals at the highest levels, which are often described using the top three levels of Bloom's taxonomy: application, synthesis, and evaluation (Krathwohl, 2002), or by using active learning methods for optimal student engagement (Huba & Freed, 2000).

Problem Based Learning (PBL) is an example of an instructional approach with those intentions, combining a learner-centered framework with a focus on the development of higher-order cognitive skills for solving authentic problems of the world (Barrows, 1986; Hung, 2006; Savery, 2015; Schmidt, 1983). PBL uses a problem scenario as the focus and starting point of the instructional process, rather than instructor-provided content organized by a sequence of topical areas (Albanese & Mitchell, 1993; Barrows, 1986; Duch, 2001). As implied in its name, PBL provides students with the opportunity to learn problem-solving skills and content knowledge within the context of carefully designed problems (Barrows, 1996). PBL adopts the view that one can develop a deeper level of content knowledge by engaging in the process of unraveling the multifaceted nature of authentic and complex problems (Barrows, 1986; 1996).

The challenge for educators and instructional designers who develop and use PBL methods is identifying which variables of the problem scenario afford the maximum level of engagement in the PBL method so learners will reap the benefits of PBL instructional approach. The PBL approach is based upon assumptions that learners will actively engage with content, their peers, and use cognitive strategies for problem-solving real issues (Barrows, 1986; Hmelo-Silver & Eberbach, 2012; Savery, 2015). In other words, the process of PBL itself and its use of real problems should be inherently motivating to sustain engagement, yet there are many nuances of a problem with the potential to impact student motivation in PBL. Hung (2016) emphasizes that the problem scenario is at the heart of successful PBL experience. His suggestion to consider the affective elements when designing problems using a model to embed these elements in the instructional design process (i.e., 2nd generation 3C3R problem design model) provides an opportunity to study whether student motivation is affected when the affective characteristics of a problem are varied in problem presentations (Hung, 2016). Purposefully modifying the design

of the PBL problem to enhance the affective attributes may create a stronger personal connection for the student with the problem, as a result creating the relatedness aspect of motivation described by the self-determination theory (SDT) (Hung, 2016).

By using PBL, students are engaging in an instructional approach with proven evidence for developing problem-solving skills. Albanese and Mitchell (1993) reviewed the PBL medical education literature over a 20-year span and concluded there is general support for PBL providing a comparable, if not a more desirable, learning experience for students and faculty. Although strong evidence supports PBL, some consider PBL more challenging and time-consuming for students than a traditional instructional approach because of the need for active participation, self-direction, initiation, and perseverance over a sustained period (Poikela & Moore, 2011). This raises a potential concern that the educational benefits of the PBL approach (i.e., improved problem-solving abilities) may be not fully realized if it is difficult to sustain motivation of students over time, or if students tire and reduce their level of interest or willingness to expend effort and engage at a high level.

Czabanowska, Moust, Meijer, Schröder-Bäck, and Roebertsen (2012) from Maastricht University expressed this concern for students in their medical school, citing potential fatigue with the PBL process as an issue, however, they continued to advocate for the benefits of PBL for their students. Student motivation while engaging in PBL is a valid concern if it is preventing students from realizing the full benefits of a PBL method. This raises the question of whether or not observed PBL fatigue can be mitigated through instructional design and methods. The purpose of this research is to explain the impact of modifying the PBL scenario subject characteristics (i.e., subject presentation type) on student motivation as measured by levels of engagement when using a PBL instructional approach.

Some argue that the design of the PBL problem is a primary source and essential context for establishing student motivation, as it is the central context of learning within a PBL instructional approach. Hung (2016) suggests the affective attributes of a PBL problem design (e.g., unsolved real-life problems and personal interest) are a central piece necessary for helping students connect psychologically with the problems they are trying to solve in a course using PBL. This argument contends the problem scenario within a PBL instructional approach has the potential to create a deeper psychological connection—and ultimately stronger motivation—for students to sustain effort and interest in the PBL method. If one purposefully constructs the problem in a manner that optimizes personal or psychological connections, there is potential for optimizing and sustaining motivation. Systematically adjusting the attributes, type, and manner of presentation of the PBL problem subject is one potential way to explore the importance of subject characteristics and the manner of problem presentation. If a difference in student engagement when using various subject presentation types is observed between different types of presentation of PBL problems (e.g., text, video, face-to-face interaction), it has the potential to provide course instructors with tools for preventing or reducing the student fatigue that occurs in repeated PBL experiences.

Problem-Based Learning and Developing Problem-Solving Abilities

Learning in a PBL approach occurs as students actively participate in the process of identifying learning issues, conducting research, analyzing information, and justifying potential solutions or recommendations (Barrows, 1986; Duch, Groh, & Allen, 2001; Savery, 2006). Students are presented with authentic problems as the context for learning content for a course, which includes purposeful elements intentionally revealed—or in some cases purposefully omitted or delayed—by an instructional designer or educator for triggering specific learning

outcomes for domain knowledge. Students gather information and integrate the knowledge into a meaningful solution or recommendation under the guidance of a facilitator who may or may not be an expert in the content area of the problem (Hung, Jonassen, & Liu, 2008).

PBL is also an example of learner-centered instruction. Learner-centered instruction is encouraged as a preferred alternative to the traditional, instructor-centered approaches (i.e., lecture-based), which have a strong history in our approach to education in the United States (Barkley, 2010; Huba & Freed, 2000; Weimer, 2013). Learner-centered paradigms emphasize students should be actively engaged and participate in collaborative activities (Huba & Freed, 2000). A logical assumption of any learner-centered instructional approach, including PBL, is the importance of having sustained and meaningful participation from students, and a high level of engagement with course content and the learning process. The PBL process is especially dependent on the active, purposeful, and cooperative engagement of students who operate in small, collaborative groups (i.e., typically four to six students) and share responsibilities for learning (Allen, Duch, & Groh, 2001; Savery, 2006).

A failure to engage with peers or the problem content will affect more than the learning of an individual student; it will affect all students in a PBL group. It is important, therefore, to optimize the factors that will motivate students to actively engage with the problem—and with each other—for the duration of the PBL problem and for the entire course if PBL is used as a primary instructional approach. In PBL, participation with peers provides a social learning environment that may be motivating for some students. Some students, however, may need additional sources of motivation for engaging in a PBL learning activity, other than knowing the problem is real (Hung, et al., 2013). Although having an inner desire for engaging in the

learning process is ideal (i.e., intrinsic motivation), Ryan and Deci (2000a) suggest we often need to be supported in this process.

Motivation in Student Learning

A credible threat to student learning occurs if, during the process using PBL, students lose interest or decrease their effort and level of participation as the result of low motivation. Hung, Mehl, and Holen (2013) expressed this concern (i.e., student fatigue) based on their experiences with implementing PBL in higher education. Their concerns extend to situations where PBL is the overall philosophy for a course with repeated exposure to problem scenarios over a period of time (e.g., semester). PBL is a significant departure from traditional instructor-led practice (i.e., passive-student model) where the instructor's authority over the student and the learning process may provide a source of external or extrinsic motivation. Students engaging in PBL for the first time may not be accustomed to having a higher level of autonomy and control over their learning activities. A benefit of PBL is its tendency to foster self-reliance and confidence in one's ability to seek out information on your own when the learner is not driven by an external reward (Barrows, 1985). The transition, however, from learning in an instructor-centered environment may be problematic for learners who are likely not used to active engagement or are at earlier stages of self-actualization as a learner (Merriam & Bierema, 2014). Therefore, it would be beneficial to design problems that trigger and foster engagement aided by the development of intrinsic motivation.

Ryan and Deci (2000a) describe intrinsic motivation as "the inherent tendency to seek out novelty and challenges, to extend and exercise one's capacities, to explore, and to learn" (p. 70). A student participating in the learning process based on their personal interests and enjoyment, rather than attainment of a tangible outcome (e.g., fear of failing a test), is demonstrating

intrinsic motivation. If one is to overcome fatigue, a desire to decrease effort, or a tendency to become more passive over the course of time, one must consider how to sustain motivation and engagement in learning activities. Ryan and Deci (2000b) assert that although individuals have an inclination and capacity for internal motivation, the SDT of motivation suggests humans may also tend to become passive and unengaged, especially when basic psychological needs (i.e., competence, autonomy, and relatedness) are not met (Ryan & Deci, 2000b). Ideally, our choice of instructional method will fulfill these basic psychological needs. If, however, it is our human nature, as suggested by SDT, to lose motivation over time, it becomes critical to consider how to increase motivation and sustain personal connections during the implementation of teaching activities and strategies.

The success of an individual PBL implementation may also be enhanced if we have a better understanding of the student perspective on which aspects of the problem will activate emotional connection, interest, or motivation for engagement during a PBL course. Hung and Holen (2011) identified potential areas for future consideration about optimizing a student connection with PBL problems, including using unsolved problems and attributes of the subject itself. For example, one may ask whether being able to hear (i.e., auditory input) or see (i.e., visual input) the person(s) involved in a problem provides an emotional connection between the student and the problem (Hung et al., 2013; Hung, 2016). A similar question to consider is how a common interest or career goal between the student and the subject or content area of the problem scenario creates a personal, emotional or psychological connection to support motivation (i.e., the relatedness component of SDT). Hung et al. (2013) raised these questions after analysis of student perceptions from using a real person during PBL implementations.

The Role of the PBL Problem Design

Several factors within the PBL process may impact success in outcomes. For example, the implementation of PBL may have variations, the PBL facilitators may have variable skills, and students may experience fatigue with the PBL process itself (Albanese, & Mitchell, 1993; Hung, 2008; Hung, Mehl & Holen, 2013). One way to address the problem of low engagement related to PBL fatigue is to consider and analyze these concerns during the problem design process by using a systematic approach to problem design using 2nd generation 3C3R problem design model (Hung, 2009; 2016). The construction and decision-making surrounding the development of a PBL problem scenario is a significant element of the PBL design and an essential factor in success of a PBL implementation (Hung et al., 2008; Hung, 2016).

Implementing a PBL approach requires the instructor or instructional designer to participate in thoughtful consideration of the potential for the problem to connect to learning objectives, which is achieved through a process described as affordance analysis within the 2nd generation 3C3R problem design model. Typically, a problem in a clinical scenario involves a description of a person facing a problematic decision or a subject of circumstances or symptoms, which is the starting point for problem-solving (Hung, 2006). However, there may be certain contexts of the problem scenario to consider including the way a problem is presented (i.e., subject presentation type), which are more intrinsically motivating, and therefore more engaging for students than others.

Subject presentation types in PBL problems. Although there are many potential characteristics of problem subjects that could be appropriate for study, the manner or presentation type in which the subject is presented may allow one to establish the relatedness aspect necessary for intrinsic motivation described in SDT (Ryan & Deci, 2000b) by eliciting an

empathetic response or a psychological connection. Other facets to consider are whether a face-to-face interaction with a real person provides a student with the motivation to actively engage, or if the connection with a problem can be obtained without a face-to-face presence (e.g., using a patient's voice via video and audio recordings to connect with a student's empathy or interests). Both alternatives may afford a higher level of motivation within the PBL experience as a PBL scenario presented as a paper case. If an emotional or psychological connection is an outcome from other subject presentation types or other factors, it may provide a deeper understanding of the consequences of modifying problem presentation to meet the needs of the learners.

As a result, faculty who design PBL courses will have a rationale for making instructional design decisions and be able to anticipate better which aspects of problems will keep their students engaged, thus maximizing the benefits of PBL. As PBL continues to expand into other professional disciplines, including Speech Language Pathology, this insight may prove especially beneficial as instructors seek evidenced-based, learner-centered approaches.

PBL within Speech Language Pathology

The discipline of Speech Language Pathology is one example of a discipline where PBL is being explored (Mok, Whitehill, & Dodd, 2008) as an evidence-based instructional approach. The SLP profession expects students to apply that knowledge in clinical problem-solving scenarios using the best evidenced-based practice (EBP) allowing them to participate as part of a multidisciplinary group (Whitehill, Bridges, & Chan, 2014). As a result, SLP courses may provide a meaningful context to explore subject presentation type and the affective components of PBL problem design through courses within their curricula. An opportunity exists to add to the body of evidence for using PBL in health sciences, through the lens of the field of speech language pathology, as it is a profession dependent upon problem-solving for people with a wide

range of communication disorders with several similarities to educational requirements seen in medicine (Whitehill, et al., 2014). The American Speech Language Association (ASHA) identified both critical thinking and problem-solving as goals for graduate training programs (ASHA, 2016a). PBL, by its nature, develops critical thinking and problem-solving abilities. Therefore, using PBL in Speech Language Pathology curriculum has the potential to address ASHA's training goals. Since undergraduate programs prepare for future graduate training programs, the issues that are relevant for preparing ideal speech language pathologists (i.e., critical thinking and problem solving) are also relevant for undergraduate courses. In addition, as Whitehill et al. (2014) mentioned, the SLP field has potential for developing challenging, ill-structured problem scenarios, a term borrowed from PBL descriptions, with its wide range of clinical disorders.

Purpose and Overview of the Study

The purpose of this mixed-methods study was to: (1) evaluate and explain the impact of using different subject presentation types in the problem design process on student motivation as measured by levels of student engagement when using the PBL instructional approach, (2) identify how other factors (e.g., personal or career interest) affected student motivation during PBL instruction from the perspective of students as they engaged in the PBL process, and (3) identify the impact on content mastery for Speech and Voice Science. These were intended to provide a deeper understanding on the benefits and/or barriers for expanding the use of PBL within the field of Speech Language Pathology in undergraduate curricula through a description of case study of PBL implementation.

The study was conducted within the context of a senior level, undergraduate course (i.e., Speech and Voice Science), within the speech, language, and hearing sciences curriculum at a

mid-sized, Midwest university. Most undergraduate students in communication sciences and disorders pursue future careers in Speech Language Pathology where they must learn to apply foundational and conceptual knowledge to the real-world experiences of their future vocations. The diverse nature of the scope of practice for SLP (ASHA, 2016c) contributes to the need to understand complex content and apply clinical reasoning to problems, which often have complex nuances and are rarely solved with only one, absolute solution.

Quantitative data was collected using observation to describe type and frequency of verbal and non-verbal engagement behaviors (e.g., questioning, commenting, researching) occurring during four consecutive PBL problem modules over the course of a semester. The PBL problems were designed using the 2nd generation 3C3R problem design model (Hung, in press), providing the conceptual framework for this study. The qualitative aspect of this study consisted of analysis of student learning artifacts (i.e., reflection papers) and investigator field notes collected during the PBL course. The qualitative data was analyzed to develop a deeper understanding of the relationship between the characteristics of the design of the PBL problem scenario and role of subject presentation type on student motivation. This subsequent layer of analysis using student and facilitator perspectives provided additional interpretation of the quantitative data to address the study's research questions.

Research Questions

The research was guided by the following questions:

1. How does the subject presentation type of problem scenario (e.g., a real person who is involved in the problem case) within a PBL problem scenario affect student motivation measured by levels of student engagement during the PBL instructional process?

   Quantitative Hypotheses

a. Hypothesis: Student motivation measured by engagement level will be the highest when working on a problem presented by a real person who is involved with the problem (i.e., a high degree of social presence: Social presence is a theory established by Short, Williams, and Christie (1976), which considers how intimacy (i.e., physical distance, body language, eye contact) or immediacy (i.e., being present) may add value or importance during interactions in instructional environments)
b. Hypothesis: There are different levels of observable engagement behaviors for the different subject presentation types of the problem scenario.
    i. *Level 1, Fictional subject, text*: a fictional subject character and problem presented using written text case description (PBL Problem 1)
    ii. *Level 2, Real subject*, *text*: a real subject and problem presented using written text case description (PBL Problem 2)
    iii. *Level 3, Real subject, audio-visual*: a real subject and problem presented using video and audio elements (PBL Problem 3)
    iv. *Level 4, Real subject, face-to-face*: a real subject and clinic problem presented in a face-to-face classroom interaction (PBL Problem 4)

2. How does one's career interest, personal connection/interest, or prior experience with subject problem content area, or other factors affect student motivation and engagement when participating in a course using PBL?
3. Does PBL provide an effective instructional method for content mastery for Speech Science learning outcomes within a Speech, Language and Hearing Sciences undergraduate course?

Benefits of Study

The benefit of this study is a contribution to the PBL literature related to PBL problem design, specifically exploring the affective components of problem design when using the 2nd generation 3C3R PBL model (Hung, in press) for problem design. It provides instructors with an example of how subject presentation type may contribute to a student's psychological connection to an authentic PBL problem scenario, and therefore affects motivation during PBL. Determining whether there is a benefit in using an authentic subject with an expanded level of personal psychological or emotional connection to the student or with subject presence is important. The process of incorporating real people as problem subjects and identifying ways to increase subject authenticity during a PBL problem scenario design is potentially time consuming and costly; thus, its value to the learning process should be demonstrated. This study is also important to the discipline of SLP. Additional examples of successful implementations of PBL at the undergraduate level are needed to provide faculty with instructional strategies that foster problem-solving and prepare students for the rigors of graduate level education.

Delimitations of Study

Although the study used a setting of convenience to the researcher—an undergraduate course from the discipline of communication disorders and sciences—it provided an appropriate context to explore subject presentation type and the applicability of PBL to undergraduate SLP curriculum. The research design used both quantitative and qualitative aspects (e.g., frequency of observable behaviors of engagement followed by student reflections, field notes, and classroom observations), providing deeper insight into understanding the relationship between the affective aspects of PBL problem design and student motivation. This combined methodology afforded an analysis that was more robust than a study using only a quantitative or qualitative research

design. The study was limited in transferability by using a convenience, non-randomized sample. However, the study sample and setting was an appropriate context for illustrating subject presentation types of the problem scenario, and as a result it offered a better understanding of the value of purposely designing problems with affective problem features (e.g., emotion, personal psychological connection, interests) using the 2nd generation 3C3R problem design model (Hung, in press).

CHAPTER II

REVIEW OF THE LITERATURE

The following chapter provides an overview of literature describing problem-based learning (PBL), including its characteristics as a collaborative, active-learning instructional method. This review will include the roles of students and faculty, examples of PBL variations, characteristics of effective PBL problems, and the effects of PBL on learning.

Because the setting for this study is Speech Language Pathology (SLP), a review of literature specific to PBL implementations in SLP graduate and undergraduate courses is included. An outline of why PBL is well suited for this professional discipline and the results of existing research on learning outcomes for SLP follows, including outcomes from the field of medicine, since this is where PBL gained momentum.

As PBL is based in part, on the premise that active engagement in learning is a source of motivation for students (Barrows & Tamblyn, 1980), a review of PBL literature concerning motivation issues and learning is included. This chapter will also review issues in PBL problem design, specifically discussing the conceptual framework, the 2nd generation of the 3C3R problem design model (Hung, in press), which was used to develop the study's PBL problem scenarios. Finally, a discussion of literature supporting the proposed operational definitions for the levels of the study's independent variable of subject presentation type is presented. This is informed, in part, by the psychological construct of social presence (Short et al., 1976) in learning environments.

The Problem Based Learning Process: What is PBL?

Whitehill et al. (2014) describe PBL as an instructional design approach and "a philosophy, curriculum design, and pedagogic approach" (p. 18). PBL is based on the premise that learning will occur at a more meaningful level, with longer term retention, when students are presented with realistic, complex problems at the beginning of the instructional process rather than at the end of a course unit (Barrows, 1986; Barrows & Tamblyn, 1980; Hmelo-Silver, 2004; Hung, 2009). PBL problems are designed around three principles considered necessary for effective learning. These include the ability to activate a student's previous knowledge on a subject (i.e., prior knowledge), the need to create a problem-solving space as close to the real world as possible to facilitate transfer (i.e., encoding specificity), and the opportunity for a student to expand and restate learning (i.e., elaboration) (Schmidt, 1983). The process of elaboration is achieved through the collaboration aspect of PBL; the encoding specificity is created via the use of authentic, ill-structured problems; and the activation of prior knowledge is stimulated from the embedded elements and characteristics of the PBL problem (Schmidt, 1983).

The desired culmination of using PBL is an improved ability for one to learn new information in the future and gain proficiency in one's ability to solve challenging problems. Hmelo-Silver and Eberbach (2012) expand on this aim by emphasizing the problem-solving outcome of PBL is complemented by improved abilities in flexible knowledge (i.e., knowing more than facts) and having an ability to make sense of new and changing knowledge. This is diametrically different than relying on a memorized answer or a textbook description, which Barrows (1986) indicated was not serving the interest of medical students in their journey to becoming proficient physicians, as they need to be skilled in diagnostic and clinical decision-making abilities rather than only demonstrating proficiency at standardized assessments. PBL as

an instructional approach emphasizes the importance of content knowledge. However, it is balanced with the importance of knowing how to use, analyze, and evaluate the information with a high degree of competence (Barrows & Tamblyn, 1980).

PBL was selected as the instructional approach for the course that provided the setting for this study (i.e., SLHS 421 Speech and Voice Science), as it provides an opportunity for students who are preparing themselves for the professional discipline of SLP to learn content and problem-solving strategies in an active and collaborative manner. PBL was also chosen for this study, in part, because of the opportunity it provides SLP students to gain confidence in their ability to direct their own learning. Autonomy is included in the summary provided by Merriam and Bierema (2014) as an attribute of self-directed learning (SDL), which includes having initiative, being involved in planning, and assessing the outcome of learning activities. Since there are several problem-oriented instructional approaches with similar and related aims that may be confused with PBL, the following is a brief discussion regarding the differences among them.

Case-based learning is an active learning approach that also supports problem-solving, yet PBL and case-based learning are not the same (Whitehill et al., 2014). Savery (2015) clarifies the similarities and differences, explaining both emphasize advanced or higher order thinking and allow students to actively engage with content and peers in learning activities. Case studies, like PBL, provide a central focus for instruction, where students practice critical thinking. However, in case based learning, the instructor is likely to have more directive tendencies leading a student to specified solutions, as the case solutions have been established with more certainty (Savery, 2015; Whitehill et al., 2014). Inquiry-learning is another active learning

instructional approach emphasizing the application of the scientific method, although the role of the instructor is more aligned with providing information (Savery, 2006; 2015) than facilitating.

Although case-based learning and inquiry learning fulfill goals of creating an active learning environment and also promote critical inquiry, the PBL approach, through its use of a tutor, fosters a supported and more individualized learning environment (Savery, 2015). The PBL approach also, via its intentional design of small group interaction, provides a space for instructors to gauge student understanding as they observe problem solving during team discussions. Perhaps just as critical, the small group interaction allows modifications or support in real-time during the problem-solving process. The combination of active learning, collaboration opportunities, inquiry skills, and self-directed learning in a supportive environment provide an appealing array of characteristics for students in SLP.

Characteristics of PBL. In PBL the instructor functions as a tutor who guides students as they actively engage in establishing learning goals and activities for solutions that may be complex or multifaceted and are not specifically prescribed in advance by the instructor (Savery, 2015). PBL problem scenarios have more than one solution or require a multifaceted approach towards resolving the problem. A common descriptive term, "ill-structured," appears frequently for the type of problems used (Barrows, 1986; Hung et al., 2008; Savery, 2006; Schmidt, 1983; Whitehill, et al., 2014). Students generate learning objectives as they collaboratively review and assess the salient features of the problem scenario in small groups (e.g., typically 5-7 students) under the guidance of a tutor who supports students as they actively engage in learning activities (Savery, 2006; Whitehill, et al., 2014). In this arrangement, the student and faculty roles in PBL serve specific purposes intended to complement and foster an active and engaged learning process.

Student and faculty roles in PBL. Students' roles in PBL align with a learner-centered instructional philosophy. Students practice higher order thinking skills while they address a problem scenario. Students in a PBL course assume responsibility for setting their learning objectives and assigning each member of their group specific tasks to initiate the learning sequence (Baral, 2010; Barrows, 1986; Schmidt, 1983; Savery & Duffy, 1995). Being able to practice making decisions about learning tasks and having the opportunity to guide one's learning are consistent with the description provided by Merriam and Bierema (2014) of self-directed learners, "SDL as a process is an approach to learning that is controlled by the learner" (p. 63). The organization of the learning activities in PBL and the recommended student roles require self-directed learning on the part of the students (e.g., identify learning tasks, conduct research). The potential of having different solutions or ways of approaching a PBL problem requires students to gather, analyze and critique information several times, providing students with opportunities to practice and gain confidence in their abilities to engage in SDL. In PBL, the problem learning objectives are deliberately not provided before initial engagement with the PBL problem, allowing students to engage in critical thinking and practice asking reasoning questions (Barrows, 1988). Students are, however, redirected by a PBL facilitator early in the process, if necessary, to ensure the process is on track and allow the facilitator to give feedback on student reasoning and thought processes when appropriate (Duch et al., 2001).

Students in a PBL classroom are expected to display accountability, and take the initiative and responsibility for their learning. However, learning is not occurring in isolation. In this sense, PBL provides a community, which is conducive for critical thinking and shared responsibility for learning (Merriam & Bierema, 2014). During PBL, students engage in collaborative groups throughout each problem. Allen, Duch, and Groh (2001) suggest assigning

specific individual responsibilities within a PBL group as a way to encourage accountability and encourage group members to gain experience in different roles. Recommended roles include discussion leader, recorder, reporter, and accuracy coach. These roles are intended to keep the group focused, provide an organizational schema for the students, prompt students to share research findings with each other, and allow space for students to engage in the reasoning process as they critically examine what they already know and question each other on what they still do not know. Barrows (1986) emphasizes an essential role of the student is making the determination of "what he needs to know" (p. 9) and through the process of continuously identifying learning needs, gathering information, and assessing how he or she may learn, students gain experience with the cognitive tasks of problem-solving. This process, Barrows (1986) contends, is advantageous to students for developing the ability to adapt to change in new learning situations and face learning challenges or obstacles. Barrows and Tamblyn (1980) also assert a student will have a higher level of motivation when they have self-identified what is significant and meaningful for them, thus creating internal or intrinsic motivation rather than motivation supplied from an external source (i.e., the PBL facilitator).

The instructors, in their role as facilitator or tutor, will assist students in meeting their learning objectives for the PBL problem by modeling appropriate questions or reasoning statements to guide students through the cognitive processes of problem-solving (Barrows, 1986; Connolly & Silen, 2015). The terms, facilitator and tutor, provide an important semantic connotation to describe the adjusted role of the instructor, which is to guide learning and model problem-solving skills (Barrows, 1986; Savery & Duffy, 1995). This is a departure from the traditional instructor role of an expert in content, which is associated with instructor-centered learning environments (Barrows, 1988; Hung et al., 2008; Leary et al., 2013). For example,

Savery (2015) suggests an instructor's role in PBL is more than the coaching aspect of guiding a student through a case study and it is definitely not a prescribed delivery of content, rather it is to "provide expert guidance, feedback, and suggestions for 'better' ways to achieve the final project" (p. 10). This depiction aligns with the principles for tutorial teaching established by Barrows (1988), which describes the tutor as "one who guides, questions, listens, challenges, and monitors" (pp. 18-19). The facilitators no longer have to be experts in a particular area (Barrows, 1986), rather their primary role is now to guide students in their reasoning process and to support them by ensuring they are asking the right questions, looking at the most appropriate resources, and staying on track with their assigned tasks (Barrows, 1988; Leary et al., 2013).

The instructor's role in a PBL learning environment starts before the delivery of the course when one prepares and designs the instructional components. Although this aspect of preparation is similar to instructor responsibilities in a traditional instructional paradigm, the instruction during the implementation of the course includes frequent engagement with learners in the form of asking questions (e.g., "why?, what do you know?, what does that mean?" (Barrows, 1988, p. 6). The facilitator also has oversight of the implementation process itself, which has specific recommended steps within the literature. Whitehill et al. (2014) describes a typical implementation or PBL module cycle as having six steps. These steps are based on guidelines initially developed by Barrows (1986) and are as follows: (1) problem scenario; (2) student-generated learning issues; (3) independent study; (4) critical evaluation of findings; (5) synthesis of information; and, (6) student reflections.

PBL Implementation Variations. An implementation may follow a "pure" PBL philosophy, meaning PBL is used throughout the course or curriculum and with no instructor-provided lectures, whereas a hybrid approach may include alternating periods of instructor-

centered content delivery (Albanese & Mitchell, 1993; Barrows, 1986; Hmelo-Silver, 2004; Hung, 2011; Hung et al., 2013). Hung (2011) described the variations of PBL models based on Barrows' (1986) taxonomy as occurring across a continuum of structure. A PBL model using case studies with high problem structure and low student self-directedness could also be described as hybrid in contrast to using problems with low problem structure and high student-led direction (Hung, 2011). Instructional approaches with partial levels of instructor-provided content and a moderate degree of problem structuredness are within the mid-range of the continuum (Hung, 2011).

Lim (2012) debated the potential for hybrid implementations to escalate into dysfunction, possibly nullifying intended purposes of PBL when attempts to appease elements of resistance from faculty result in important compromises within the execution of the PBL module (e.g., faculty reverting back to content delivery as the "expert"). He summarizes potential pitfalls with a hybrid PBL curriculum as including resistance from faculty, inappropriate use of lectures, failure to prepare for designing curriculum, and unsupportive leadership. Lim (2012) also states "lectures in a PBL curriculum should be consistent with the PBL philosophy of active, deep, and self-directed learning" (p. 5). In support of deviations from a pure implementation of PBL, he provides the following example. If students initiate a request for lecture content because it is critical to their learning at a specific time in the process, it aligns with student-directed learning and therefore would be consistent with the aim of PBL (i.e., fostering initiative, self-reliance).

A debate exists within the literature on how differences across implementations impact interpretations on the success of a PBL. Adding complexity to the discussion of comparing the effectiveness of the learning approach are the variations of curriculum design, problem type, problem design, and unique features of disciplines that use the process (Albanese & Mitchell,

1993; Hung, 2009; 2011). The implementation variation for this study was a pure variation of PBL intended to provide learners with maximum opportunities to engage in active learning and foster self-directed learning throughout the course. Using a pure variation, rather than a hybrid, may also provide some control over introducing confounding variables. Since the purpose of this study was to explore and understand the effects of different subject presentation types on student motivation within PBL learning environments, it was advantageous to follow a pure PBL course format implementation.

PBL Problem Characteristics. The problem scenario is an essential element of PBL and sets the stage for learning to occur (Barrow, 1986; Hmelo-Silver, 2015; Hung, 2016). Jonassen and Hung (2015) summarized the consensus within the PBL literature for PBL problem attributes, emphasizing PBL problems need to have complexity, a challenging nature, a motivating aspect, and the ability to engage students in the learning process for optimal effect. This depiction is consistent with characteristics of effective PBL problems described by Duch (2001), which adds "a problem should either be open-ended, based on previously learned material, and/or be controversial so that students in the groups are initially drawn into a discussion" (p. 49). Although it might be assumed, a good problem also requires students to use higher levels of Bloom's taxonomy (Krathwohl, 2002; i.e., analysis, synthesis, and evaluation). Stanton and McCaffrey (2011) expanded on these descriptions of PBL problems, noting effective PBL problems should reflect real life situation or current practice, intentionally activate prior knowledge using diverse, use multidisciplinary sources when possible, and provide an amount of structuredness that is not too prescriptive, yet not too open-ended. Stanton and McCaffrey (2001) also suggest using strategies to foster group discussion and debate, which include using trigger questions related to the PBL problem as an adjunct to PBL problems.

Lacking from these descriptions of quality problem characteristics is the perspective of students who engage in PBL problem solving. Sockalingam and Schmidt (2011) addressed this issue in their study seeking an understanding of important problem characteristics from students' perspectives using the analysis of reflective essays from 34 students enrolled in Biomedical curriculum in Singapore. Through their narrative analysis of student essays, they identified that students considered PBL problems that led them to the intended learning issues as useful PBL problems. The study participants ranked this characteristic the highest, followed by problems that triggered interest and problems that had an appropriate format (i.e., avoid excessively long text or the include of a visual). In the interpretation of their results, Sockalingam and Schmidt (2011) suggested problem format might be an initial consideration and important consideration of students. Problem format may affect learner interest for engaging in PBL, creating support for considering the modality in which a problem is presented (i.e., visual, text) as salient features for consideration in problem design. The question of whether a visual creates a lower cognitive load on the learner or if one has a visual learning style is also a factor to identify when designing PBL problems per Sockalingam and Schmidt (2011).

This interpretation of "good" problem characteristics is significant from the perspective of those who design PBL problems as it raises the question of whether there is a need to consider a more nuanced level of problem characteristics, expanding on how a problem resembles or uses a real problem scenario. For example, the realism of the problem (i.e., authentic) is considered instrumental relative to student motivation for engaging in the PBL process from the perspective of Barrows (1986). Sockalingam and Schmidt (2011), however, identified the format of the problem as an additional PBL problem characteristic for contemplation as it was identified by students in the study as being relevant from their perspective. Students also favored PBL

problems that led to learning issues and problems that trigger interest or curiosity (Sockalingam and Schmidt, 2011). The clarity of the problem and the students' perceptions of problem difficulty were also interpreted by the students as attributes of quality PBL problems, potentially affecting student interest for solving a PBL problem.

As a result of their analysis, Sockalingam and Schmidt (2011) categorized problem characteristics as being either a problem feature or a problem function. A problem feature was described as format, clarity, familiarity, difficulty, and relevance. A problem function refers to a problem that leads to learning issues, triggers interest, stimulates critical reasoning, promotes self-directed learning, stimulates elaboration, or promotes teamwork. Their purpose in this organization is to illustrate how it is possible to modify and alter features of a problem without losing sight of the intended function of a PBL problem. Problem characteristics that stimulate elaboration or promote teamwork were the lowest ranked attributes from the perspective of the students, yet remain a desired outcome of the PBL learning process. Given the number of considerations expected in quality PBL problems and ongoing challenges to balance problem difficulty, complexity, and structuredness in PBL problem design (Jonassen & Hung, 2015), it is not unrealistic to envision varying levels of learning outcomes and student acceptance when comparing PBL implementations.

Effects of PBL on Learning Outcomes

The largest source of evidence on the effects of PBL on learning originates from the discipline of medicine. Dochy, Segers, Van den Bossche, and Gijbels (2003) completed a meta-analysis of 43 studies to assess the effects of PBL on outcomes for knowledge and problem-solving skills. As an instructional approach, PBL aims to facilitate content knowledge of foundational concepts and the subsequent application of knowledge for solving problems, which

requires higher order cognitive processes (i.e., synthesis and evaluation). Dochy et al. (2003) identified strong, positive study effects for a student's ability to apply knowledge skills across studies and a positive effect for a student's ability to retain knowledge as compared to traditional instruction methods. Dochy et al. (2003) noted their findings were consistent with a previous meta-analysis performed by Vernon and Blake (1993), which indicated stronger clinical skills for students using PBL when compared to a traditional curriculum. Albanese and Mitchell (1993) also completed a meta-analysis finding evidence for PBL supporting content knowledge, and Yew and Schmidt (2012) identified collaborative learning as a significant learning outcome. Overall, these studies assert PBL has evidence supporting its effectiveness for its primary aims, the ability to build skill in acquiring knowledge while developing higher order skills associated with problem solving (e.g., asking questions, analyzing research, evaluating options) in a collaborative and active learning environment. It is, however, still relevant to consider how PBL as a learning approach aligns with the discipline for this study.

The PBL Process: Why use PBL for Speech Language Pathology?

Speech Language Pathologists are professionals who treat individuals with communication and swallowing disorders, including areas of speech sound production (i.e., articulation), fluency, language, cognition, hearing, resonance, and voice (ASHA, 2016c). This diverse range of practice areas requires SLP practitioners to acquire knowledge at the undergraduate and graduate level pertaining to knowledge domain areas of biological sciences, physical sciences, statistics, social/behavioral sciences. These foundational areas are in addition to specific knowledge of communication and swallowing disorders, which often have underlying medical origins (ASHA, 2016c). The professional and educational standards for SLPs have several similarities to the field of medicine (Whitehill et al., 2014). For example, both

professions include a diverse range of required foundational knowledge, and the development of diagnostic and clinical skills. Professionals seeking certification as an SLP must meet competency standards from the American Speech Language and Hearing Association (ASHA, 2016a), which include demonstrated abilities to "interpret, integrate, and synthesize core concepts and knowledge" and "incorporate critical thinking and decision-making skills while engaged in the evaluation, diagnosis, planning, implementation, and/or intervention" (para 5) of communication and swallowing disorders.

The collaborative, learner-centered, and self-directive aspects of PBL appear well-suited for the discipline of SLP, especially PBL's identifying and hallmark feature of focusing on developing problem-solving skills. This purpose of PBL is complementary to the skills and competencies for SLPs. For example, the ASHA professional competency of "interpreting, integrating, and synthesizing all information to develop diagnoses and make appropriate recommendations for interventions" (ASHA, 2016b, Standard V-B, 1.e) is an example of higher order cognitive skills supported by PBL. In addition, professionals in the SLP field engage in a cyclical process of collecting, analyzing, and evaluating data as a way to measure client progress. SLPs routinely evaluate or assess performance and modify therapeutic clinical methods (ASHA, 2016a), providing another illustration of how higher-order cognitive skills are embedded in SLP professional competencies. These competencies are generally not mastered after an isolated course project or one assignment; they develop gradually through multiple opportunities during education experiences. One may argue the same concerns of medical education (Barrows, 1986) also apply to SLP; traditional teaching methods (e.g., lecture) do not facilitate the development of professional competencies necessary for successful clinical practice as an SLP.

The ability to make clinical decisions is another professional competency and educational goal of graduate training programs in SLP (ASHA, 2016a). Whitehill et al. (2014) support the use of PBL in SLP training and education based on similarities in prerequisite course work and later application of knowledge in clinical settings. Burda and Hageman (2015) mirror this support for PBL based on their view that SLP practitioners need reasoning skills for both clinical and research aspects of the profession. The inquiry process of asking clinical or research questions, gathering of data, and engaging in evaluation is consistent with the position of ASHA that SLPs are expected to use evidence-based practice (EBP) in their clinical decision-making (ASHA, 2005). ASHA defines EBP as "the integration of: (a) clinical expertise/expert opinion, (b) external scientific evidence, and (c) client/patient/caregiver values to provide high-quality services reflecting the interests, values, needs, and choices of the individuals we serve" (ASHA 2016f, para 2). Visconti (2010), an instructor who uses PBL activities in a communication disorders courses, states "PBL lays the foundation for the skills that clinical fields require in their development and use of evidence-based practice (EBP)" (p. 30), making a valid argument for the symmetry between PBL and EBP in the discipline.

Greenwald (2006) also supports the argument of the complementary nature of PBL and EBP in the SLP profession through her description of how PBL problems are appropriate for a research methods course. Greenwald (2006) states both PBL and evidence-based practice (EBP) "require students learn to ask relevant questions, locate research resources, and critically review the research literature" (p. 173). Greenwald (2006) connects the current shortage of researchers in the SLP field as a justification for using PBL. She holds the position that students will have a deeper level of appreciation for learning research techniques using the critical reasoning process if practiced in a PBL format. She envisions PBL as facilitating a student's deeper understanding

of different experimental designs by using active learning and learner-centered instructional activities (e.g., problem solving, group discussions, and class debates). PBL will, in Greenwald's (2006) opinion, help students "extend clinical questions into research questions" (p. 179), which hopefully will draw more graduates into research for the profession.

SLPs, like physicians and other professionals in the 21st century, also engage in learning activities after the courses of graduate school are finished. This ongoing education requirement, the evolving nature of clinical information, and emerging research in communication disorders make it necessary for SLPs to engage in life-long learning. With its emphasis on self-directed learning (Barrows, 1986; Hmelo-Silver & Eberbach, 2012) PBL delivers another promising aspect for SLP, creating a skill set for learners to be able to initiate and direct their learning. From their experiences with using PBL in SLP courses, Burda and Hageman (2015) provide affirmation of this benefit in their assertion that "PBL sets students up to be life-long learners" (p. 48).

ASHA and the Council of Academic Programs in Communication Sciences and Disorders (CAPSCD) have embraced the value and importance of interprofessional practice for professionals in the field (ASHA, 2016d). Using the Interprofessional Education Collaborative (2011) expert panel as a guide, ASHA advocates for its members to be competent in interprofessional communication, and embrace the use of teams and teamwork for providing safe and effective care to SLP clients. PBL, through its structure of small, learner-centered groups, provides a space for students to collaborate and supports the development of skills for effective teamwork (e.g., communication, sharing responsibilities). In PBL the interaction is more than just between the student and the content, rather PBL promotes interaction and teaching among peers as way to strengthen and understand content knowledge (Hmelo-Silver & Eberbach, 2012).

In responding to the original question of why PBL is appropriate for SLP, there are several answers. First, PBL's aim of higher order problem solving skills aligns with the professional competencies of the profession and support life-long learning. In addition, the skills necessary for following the principles of EBP in clinic and research settings are practiced in the PBL process. Finally, the structure of PBL emphasizes teamwork and collaboration in its design, which complements the trend toward interprofessional practice in the work settings of SLPs.

Existing Literature for PBL in Speech Language Pathology

Although PBL has extended beyond its original domain of medicine to several other fields, it is emerging more slowly within the disciplines of Speech-Language Pathology and Audiology within the United States (Burda & Hageman, 2015; Greenwald, 2006; Visconti, 2010; Tharpe, Rassi, & Biswas, 1995). In the United States, references to PBL for SLP are primarily with individual graduate courses including: graduate level courses for research methods at Wayne State University (Greenwald, 2006), cognitive communication disorders courses at the University of Central Florida (Kong, 2014), and in adult neurogenic disorders at the University of Northern Iowa (Burda & Hageman, 2015). Examples at the undergraduate level are scarce in the literature, however, Keegan, Losardo, and McCullough (2017a; 2017b) describe an implementation using a dual approach with service learning and PBL in an undergraduate course for adult language disorders. Keegan et al. (2017a) describe using a combination of PBL with community service learning experiences to balance aspects of active learning and constructivism. Their assertion is that PBL with face-to-face experiential component (e.g., volunteer service experiences related to clinical diagnoses) is an advantageous way for undergraduate students in communication disorders to become self-directed learners. The communication disorders undergraduate program at Baldwin-Wallace College provides another example; they have

embedded different variations of PBL learning activities into several courses, although it appears to represent more project level applications (Visconti, 2010). Prosser and Sze (2014) noted the scarcity of research exploring specific learning outcomes for PBL curriculum within speech language pathology.

PBL in individual SLP courses. Descriptions of two domestic implementations of PBL in SLP at the graduate level appear in the literature by Greenwald (2006) and Kong (2014). One of the specific learning outcomes of Greenwald's (2006) research course, in addition to teaching students specific research skills, was expanding students' abilities for participating in evidence-based decision making, as previously discussed. In her piece advocating for the use of PBL in graduate courses for research, Greenwald (2006) did not describe or elaborate on any specific assessment of cognitive learning outcomes resulting from using PBL. Rather, she concluded the PBL approach facilitated students using evidence- based practice, presumably from her impressions as the instructor of the course. Greenwald's conclusion was the PBL approach complements and extends a student's knowledge of the clinical diagnostic process and may promote student participation in research in later stages of their education and career. Missing from Greenwald's (2006) article supporting PBL for teaching research methods is evidence of the efficacy of the desired outcome of critical reasoning. Her arguments are logical, yet additional research affirming the gains in research abilities or the use of evidence-based interventions are needed. Greenwald (2006) did provide compelling examples of using a variety of problem scenarios relevant to SLPs including autism, aphasia, and other administrative topics that affords students with different learning contexts. The application of PBL to a course focused on research methods supports the use of PBL in related SLP courses with learning objectives that are not limited to content knowledge on specific clinical disorders. The undergraduate course for

this study (i.e., SLHS 421 Speech and Voice Science) includes learning objectives that are not restricted to specific clinical disorders. Foundational domain and conceptual knowledge for speech articulation, voice, phonation, and speech acoustics were incorporated into problem scenarios.

Kong (2014) addressed the outcomes for a hybrid implementation of PBL in a graduate level SLP course on cognitive communicative disorders. In his study, he completed a qualitative analysis of student journal reflections to further understand student perceptions of using PBL in SLP. Specifically, he asked the research question of whether student perceptions of PBL would evolve over time as they gain more experience with the PBL format. Kong (2014) found the majority of students in his course provided reflective statements consistent with a positive PBL learning experience, although similar to Greenwald's (2006) piece, specific cognitive learning outcomes were not measured directly.

Overall, Kong's students perceived more advantages from participating in the PBL process than disadvantages. The students' continued exposure to PBL over the duration of the course helped erase some of the initial negative perceptions. Positive themes identified by the students included support for collaborative learning from peers, better understanding of knowledge, improved application of content, and becoming more motivated to seek new information on concepts (Kong, 2014). Kong considered the hybrid format of this course as a study limitation. His description of hybrid appeared to be based upon the inclusion of a service learning aspect where students directly interacted with clients with cognitive communicative disorders. In his analysis, Kong (2014) suggested an opportunity exists for enriching PBL. He suggested future courses include "direct client contact or observation" (p. 69) as a supporting PBL resource or an alternative to the typical presentation of information (i.e., case summaries,

videos). Kong did not elaborate on his perceptions of this potential benefit; however, his suggestion does inform this study and the use of subject presentation type with varied levels of social presence as an independent variable.

With regard to cognitive learning outcomes, Kong (2014) described student feedback that included student acknowledgements of critical thinking and knowledge application occurring during the course. This was interpreted as positive support for PBL supporting the development of cognitive problem-solving abilities for these students. This study did not directly measure cognitive learning outcomes from observable measures other than the student perceptions, yet it does describe how PBL fits in a SLP context. Kong also suggested additional studies for expanding PBL in SLP may be informative on other potential uses for PBL in SLP discipline. Both Greenwald (2006) and Kong (2014) provide initial support and rationale for continuing to investigate PBL implementations in SLP to develop a body of evidence specific to the field of SLP. However, neither description of PBL at the course level included outcome data on content mastery, or specific observable measures of different levels of engagement during the different PBL scenarios in their studies, providing a potential opportunity for future research.

In Visconti's (2010) description of PBL activities at Baldwin-Wallace College, she reported on student survey feedback from the 135 undergraduates who participated in learning activities based on PBL principles from 2007 to 2010 in various PBL learning modules and projects. Student perceptions of their own gains in critical thinking, communication skills, and research ability was overall positive, with 75% indicating the PBL aspect allowed them to synthesize information at an improved level. This description of PBL activities within an undergraduate context also did not formally measure cognitive learning outcomes through observation of changes in student behavior as they participated in PBL. Visconti's survey,

although informal, does provide indirect support for using PBL in an undergraduate SLP setting based on positive perceptions of PBL from students in their abilities to engage in learning tasks associated with problem solving (i.e., researching, application, and synthesis). From this review of existing course implementations there is a limited amount of outcome data, yet all of the authors were supportive of the value of PBL for their courses.

PBL at the curricular level in SLP. Speech language pathology graduate programs located in Australia (Erickson & Serry, 2016; Slattery, 2014), Hong Kong (Ho, Whitehill, & Ciocca, 2014) and Sweden (McAllister et al., 2014; Samulesson, Lundeborg & McAllister, 2014) have transitioned to a full PBL model for their entire curriculum, in addition to partial implementations in Ireland and the United Kingdom (Mok, Dodd, & Whitehill, 2009). PBL has also been implemented in an online environment in Hong Kong (Ng et al., 2014). Studies that directly measure and observe changes in student behaviors related to higher order problem solving abilities during the PBL process, rather than student perceptions of their abilities, appear to be scarce in the literature for PBL in SLP.

The potential for expansion of PBL in SLP programs in the United States is promising, although it has not been fully embraced at the curricular level to the same degree as it has been in international SLP training programs in Hong Kong (Ho, Whitehill, & Ciocca, 2014), Sweden (McAllister et al., 2014; Samulesson, Lundeborg & McAllister, 2012) and Australia (Erickson & Serry, 2016; Slattery, 2014). The review of research describing PBL implementations did not identify any graduate programs within the United States using PBL as a curriculum, only course level implementations previously described (Burda & Hageman, 2015; Greenwald, 2006; Kong, 2014).

As PBL continues to expand within the curricular requirements for the discipline of SLP, the challenges that have been identified for PBL for using the process in general may also be challenges for implementations within SLP. Therefore, it is appropriate to discuss some of the concerns that have been encountered in other disciplines using PBL as it pertains to sustaining effort and maintaining motivation during PBL, and also the overall importance of motivation in learning.

Maintaining Student Motivation in PBL

Maastricht University in the Netherlands has used PBL in its medical school curriculum for more than 30 years. Despite strong student satisfaction and positive learning outcomes, they identify a significant concern—the reduction in active learning behaviors that they describe as a gradual erosion among students (Czabanowska et al., 2012). As students engage in repeated PBL activities, a tendency was observed for some students to become less participatory and less enthusiastic about active engagement. Their concern was that the positive impact of a PBL philosophy was being minimized as a result of repeatedly using active learning and self-directed learning activities of the PBL process itself. Czabanowska et al. (2012) described this pattern of behavior or being underprepared as "PBL fatigue" (p. 2). This description aligns with research conducted by Moust, Berkel, and Schmidt (2005) showing students skipped steps or may come to group meetings in PBL underprepared because of fatigue from repetition of PBL cycles. Fatigue in a higher education learning environment is not unique to a PBL setting (Beard, Clegg, and Smith, 2005). As noted by Beard et al. (2005) in their case study describing the emotional journeys of students' first year in a university setting, statements made by students like "feeling tired at the moment, makes it hard to keep going," (p. 247) were occurring by mid-point of the semester. What appears to be unique to the PBL fatigue described by Czbanowska et al. (2012)

are the specific connections to the instructional method and the reasons behind the fatigue. In the piece by Beard et al. (2005) fatigue was described as connected to external factors (i.e., poor sleep, accumulating responsibilities) of student life rather than intrinsic to any one instructional experience of the students making PBL fatigue a more precise interpretation of fatigue. Therefore, fatigue may be a product of the potential difficulty or burden of an active learning instructional method rather than a more generalized consequence of a higher education learning environment.

Czbanowska et al. (2012) identified two areas of concern that they hypothesized contribute, in part, to PBL fatigue. The first was a concern of the tendency for PBL modules to veer towards a more directive, instructor led format, which may reduce student motivation to identify and explore topics on their own. The second concern was potentially an effect of the decreased active participation, a level of surface learning that may or may not trigger interest or motivation for a student. They also considered the possibility that brain development for cognitive processes in young adults develops along a continuum and may result in different levels of readiness for higher order cognitive learning activities. For example, if brain development is not matured some learners may require additional support for executive functioning tasks of planning, setting priorities, synthesizing and evaluating information (Blakemore and Frith, 2005), as cited by Czabanowska et al. (2012). Depending on maturation of these executive functional abilities for young learners, it is reasonable to associate fatigue or perhaps a reduced amount of motivation to participate would increase with recurring exposures to the process (i.e., PBL), especially if the challenge and cognitive load for these activities was high for some students as posited by Czabanowska et al. (2012).

In response to these concerns, the faculty at Maastricht University developed a model for PBL—active and self-directed learning (ASDL)—that created different phases in the learning cycle of PBL illustrating ways to reexamine how the activities were matching the aims of PBL (i.e., deep connection to material through elaboration, analysis, and synthesis). These phases—sensitization, exploration, integration, and application—also emphasize students may be at different levels at different points of time, therefore requiring distinctive types of scaffolding and support that evolves throughout repeated exposures to PBL in a curriculum. One phase of this model in particular, sensitization, applies to motivation. Czabanowska et al. (2012) states the purpose during this phase is "for the students to become cognitively and emotionally involved with the subject" (p. 4), resulting in increased motivation for engaging in the PBL process and potentially combat future problems with fatigue. It is therefore, reasonable to consider what aspects of the PBL problem will facilitate this phase of sensitization for problem solving in PBL. After applying their ASDL model to a new curriculum in Public Health at Maastricht University to address the concerns of fatigue during PBL, the authors concluded the application of their model and its attempt to enhance how students perceive the learning environment was an appropriate step forward in the evolution of PBL at their university, stating "more attention should be paid to such aspects as students' concepts of learning, their motivation and learning goals" (p 11).

In comparing two different PBL course implementations in higher education, Hung et al. (2013) provides an example of another study focusing more attention on the role of motivation in PBL. PBL problems are expected to represent authentic problems (Barrows, 1986), however, Hung et al. (2013) noted if the problem design has poor authenticity there is potential for lower motivation, which would extend to lower levels of engagement. This argument informed their

interest in examining engagement and attention by students and its connection to the problem characteristics. Hung et al. (2013) examined the relationships between cognitive aspects of self-directed learning and attributes of PBL problems. They were also interested in the psychological aspects of motivation and subsequent engagement. Hung et al. (2013) noticed in their review of the literature that research has previously focused more heavily on learning outcomes for PBL for specific areas (e.g., content or domain knowledge, problem-solving skills) without more explicitly evaluating the role of interpersonal relationships and personal engagement in the PBL process.

Although each course in their case study comparison (Hung et al., 2013) was different in PBL structure, in terms of length and number of PBL modules and format (i.e., pure PBL versus hybrid PBL), both courses used real people as subjects throughout the problem presentation stage. These problem subjects were also present at the end of the PBL module when the students provided solutions to the proposed problems. Hung et al. (2013) considered a number of issues as potential factors affecting motivation, including the hypothesis that fatigue of a physical and/or psychological nature may result from completing successive PBL problems. They noted some complaints from the PBL group that had six consecutive PBL problems as compared to the other PBL implementation, which had only one PBL problem. Other suggestions provided by the students after completion of the study included a recommendation to include fewer problems overall (i.e., four or five) and increase total problem duration work time to either two and one-half or three weeks, rather than two weeks (Hung et al., 2013).

Analysis of student perceptions between the two cases revealed students embraced having a real person to direct questions toward and serve as a frame of reference. As a result of their comparison of two separate PBL implementations, Hung, et al. (2013) identified additional

layers of complexity related to the PBL problem characteristics that may influence psychological connections between students and the problem, potentially enhancing motivation during PBL. Specific characteristics or variables of the problem design pertaining to the subject and problem context were proposed as contributing to a problem having a stronger authenticity aspect including: (1) subject presence (i.e., physical access); (2) location proximity (i.e., distance); (3) temporal proximity (i.e., recent event); (4) personal interest proximity (i.e., relevance); and (5) career interest proximity (i.e., alignment with career goals). These proposed variables "enhance the human element of the problems, and as a result the students' psychological and emotional engagement was increased during the problem-solving process" (Hung et al., 2013, p. 649). This study, through its consideration of the relationship between PBL problem design variables and student psychological considerations, presents novel variables for future research. It specifically informed this study by providing design considerations for the subject presentation of the PBL problems.

Motivation and Student Learning

Motivation, regardless of whether it derives itself from an internal source (i.e., intrinsic) or the result of an action or object in one's environment (i.e., extrinsic; Merriam & Bierema, 2014) is studied and applied to learning environments because it is associated with facilitating efforts to meet learning goals. Reeve (2012) describes motivation as having dual aspects of energy and behavior, allowing individuals to be goal oriented and directed. Ryan and Deci (2000b) also describe motivation as especially important for teachers who need students to take action (e.g., research topics, engage in discussion). Motivation also has an important relationship with the design of instruction (Pintrich, 2003). Pintrich (2003) summarized generalizations about motivation and the connection to different instructional design principles. For example,

providing interesting tasks with novelty and variety is associated with higher levels of intrinsic motivation. In a similar manner, tasks that are relevant provide a specific use or value generalize to higher motivation. This also applies to tasks that build in a level of choice or that are done in collaborative groups. Motivation in a learning environment may create an immediate ability to stay on task and attend to instruction. Pintrich (1999) describes the value of motivation in student learning as being linked with self-regulation skills, specifically tendencies to modulate learning behaviors (e.g., setting learning goals, monitoring understanding, using strategies) are enhanced with increasing motivation. The connection between motivation and self-regulation is important in a PBL environment because self-directed learning activities require self-regulation. When using a PBL instructional approach motivation is essential to consider because PBL is framed around key assumptions of student responsibility for learning, collaboration, and the ability to maintain effort throughout the PBL learning process (Savery, 2015).

One's beliefs about the value of the task also impacts motivation to use self-regulation strategies (Pintrich, 1999). If students have a belief that the educational activity has value, importance, or serves a useful purpose it will be positively associated with motivation to use self-regulated learning strategies (Pintrich, 1999). In a PBL learning environment, externally regulated or extrinsic motivations are not at the forefront, rather students are required to take responsibility for learning (i.e., self-directed learning) often outside of the classroom where intrinsic motivations are needed. Ryan and Deci (2000b) noted there is a human tendency to gravitate towards passivity on the spectrum between external and internal motivation. In a classroom setting it is reasonable to assume a student who is passive and unmotivated is less likely to actively engage in learning activities.

Motivation typically is considered to precede engagement (i.e., involvement in an activity), however, since motivation is not overtly observable the behaviors associated with engagement are a way to measure motivation (Reeve, 2012). In discussing the relationship between motivation and engagement in a learning environment Reeve (2012) suggests student learning environments are so connected with student motivation and engagement it is difficult to separate the two constructs in the context of a classroom. For example, Reeve suggests a teacher's role is not to create motivation, rather it is to support the level of motivation a student brings to the classroom in either a high or low-quality manner. Providing support, however, is instrumental in fostering and ideally increasing motivation from that point forward resulting in engagement with learning activities. Using this logic, a PBL problem also may provide high or low-quality support for motivation as observed by different engagement behaviors. Definitions of motivation and engagement are informed by the self-determination theory (SDT).

SDT theory provides a rationale and basis for tendencies in human motivation based on our needs to have basic psychological needs (i.e., autonomy, competence, and relatedness) met (Ryan & Deci, 2000b; Reeve, 2012). Ryan and Deci (2000a) describe these basic needs as dimensions of intrinsic motivation. Ryan and Deci (2000b) posit SDT "intrinsic motivation is more likely to flourish in contexts characterized by a sense of security and relatedness" (p. 71). PBL, through its collaborative design and use of self-directed learning tasks, already provides an opportunity for autonomy and competence. Relatedness, however, is an aspect of SDT that has not been fully explored in PBL. SDT suggests a context that provides a sense of relatedness may allow intrinsic motivation to thrive because it is creating a psychological connection (Ryan & Deci, 2000b). Therefore, it may be beneficial to consider whether there are characteristics of a problem that may create a personal psychological connection or sense of relatedness to develop.

Connections via affective components are a key aspect of this study's conceptual framework, the 2nd generation 3C3R problem design model (Hung, in press). PBL problem design, therefore, may provide a means for heightening motivation during learning if the elements that contribute to relatedness are incorporated into the PBL problem. Understanding the process of developing PBL problems and existing literature on problem design is an important next step.

PBL Problem Design

In response to a need in the PBL field for obtaining a level of consistency and systematic guidance in problem development, Hung (2006) created the 3C3R PBL problem design model and also a set of guiding steps for applying the model to problems (Hung, 2009). This model, and its subsequent 2nd generation version (Hung, in press), provides a conceptual framework for the process of designing problems with an appropriate amount of problem structuredness and complexity (Hung, 2016). The 2nd generation 3C3R PBL problem design model reinforces the need for a problem to support content knowledge and problem-solving skills, while taking into consideration the potential emotional and psychological characteristics of problems, an important addition in the 2nd generation evolution of the model (Hung, 2016). An anticipated advantage of this conceptual framework is the ability for individuals who are involved in the design process to use common terminology, balance areas of emphasis, and also create a common basis for comparing problems, (Hung, 2016). This problem design model also offers the person who is designing the problem with a procedure for aligning the scope of the problem with the learning objectives and way to assess if the problem has the appropriate structure and complexity (Hung, 2009).

Since the design of the PBL problem is a probable source of variability for achieving learning outcome and is also a central feature of using PBL (Hung, 2016), it is reasonable to

employ systematic steps when designing problems. Hung (2009) noted potential areas of concern and/or sources of variability in problem design including: inadequate content coverage, mismatch of learners' abilities for problem solving, and students developing an unintended focus on off-topic areas from the actual problem. Each of the major areas of the 2nd generation 3C3R model were operationalized in more detail by Hung (2009) in his nine-step design process creating a method for instructors to follow to ensure their problems are sufficiently aligning with the intended learning outcomes. The steps for problem design are as follows: (1) set goals and objectives; (2) conduct content/task analysis; (3) analyze context specification; (4) select/generate PBL problem; (5) conduct PBL problem affordance analysis; (6) conduct correspondence analysis; (7) conduct calibration processes; (8) construct reflection component; and, (9) examine inter-supporting relationships of 3C3R. These steps follow a logical order, and provide a useful tool for instructional designers and instructors who wish to consider a PBL implementation but are uncertain how to approach course design. The inclusion of the reflection component is also an important way for instructors to learn how to improve the process of problem design since each iteration in subsequent implementations may result in optimal ways to enhance motivation (Hung, 2016).

The 2nd generation 3C3R problem design model considers problems from three perspectives: a content knowledge perspective (i.e., a core component), a problem-solving aspect (i.e., processing component), and an affective or interaction perspective (Hung, 2016) (See also Figure 2). At the center of the 3C3R model are three aspects of content knowledge: content, context, and connection, hence its use of "core" as a key descriptor and origin of the 3Cs (Hung, 2006). These core components "are concerned with structuring content knowledge, contextualizing domain knowledge, and building a conceptual framework around the topic under

study" (Hung, 2009, p. 122). The processing aspect of this framework "is designed to facilitate mindful and meaningful engagement in PBL" (Hung, 2006, p. 62) through the researching, reasoning, and reflective aspects of the problem. With the addition of affective elements, the 2nd generation of the 3C3R problem design model provides a guide for considering an additional layer for enhancing the authenticity problem, and ideally creating optimal motivation. For example, there may be elements of the problem related to psychological aspects of emotion, motivation, empathy, or a personal connection, which affects how a student interacts with the problem, their peers, or even the self-directed learning process of PBL. The affective component of the 2nd generation 3C3R model guides the development of authenticity of a PBL problem, leading the problem designer to consider whether triggering psychological aspects (i.e., personal connection, empathy, or personal experience) will influence student motivation during the problem-solving process. Being able to foster relatedness—one of the basic psychological needs for motivation created through the connection with others (Ryan and Deci, 2000b; Reeve, 2012)—is suggested as a way to enhance a greater sense of ownership by the student involved in PBL (Hung, 2016). The affective component provides a mechanism for increasing the probability of motivation when solving a real-life problem since motivation is not always an automatic consequence when using a real-life problem (Hung, 2016).

PBL Implementations using 3C3R. Xue et al. (2013) used the original 3C3R PBL problem design model as their conceptual framework for developing a PBL problem for their pediatric medical school, citing the need to consider standardizing PBL problem development given a lack of established protocols for problem development in China. To measure the effectiveness of the 3C3R problem design model, they revised an existing PBL problem lesson from their curriculum using 3C3R conceptual framework, which includes an explicit

consideration of content, context, connection, research, reasoning, and reflection of Hung's (2009) nine-step process for applying the 3C3R framework. Medical students were randomized into tutor groups, with three groups using the revised problem and three using the traditional PBL problem. The process for traditional PBL problem design was not described. After the PBL lessons, Xue et al. (2013) surveyed students and tutors about each aspect of the 3C3R. For example, to assess effectiveness of the problem content they asked if the information provided in medical history was complete and understandable. For assessment of whether the problem afforded students with reasoning, students self-assessed if their discussion tasks provided opportunities for developing reasoning. Xue et al. (2013) found a significant improvement in student ratings of connection and reflection from the students who were in groups using the 3C3R version of the problem. They described the model as "helpful in PBL problem design" (p. 8) and providing an overall positive benefit for their medical students learning about pediatrics. The instrument used in their study, however, did use the labels directly from the 3C3R components (e.g., content, connection) in their assessment tool, which may have influenced their ratings. However, this study provides a solid example of perceived value when using this conceptual framework for problem design. Their description of the problem development using the 3C3R framework provides a clear rationale and carefully constructed roadmap for how problem aspects link to curriculum objectives in a clinical curriculum. The addition of the affective element to the model, the 2nd generation of the 3C3R problem design model, creates a useful tool for PBL problem design and for this study proposal. The affective aspect of the model provides guidance for designing a PBL problems based around different levels of social presence for the type of subject presentation within different PBL modules, which is the independent variable for this research study.

The PBL problem presentation format. The process of instructional design requires one to consider the goals of instruction, a strategy for reaching goals, and a modality or vehicle for presenting instructional content to a student (Smith & Ragan, 2005). The problem scope and the decisions on which concepts to include when presenting a PBL problem, represent one aspect of problem presentation (Hmelo-Silver, 2015). The presentation format or modality of the problem or the subject of the problem represent another aspect. Barrett, Cashman, and Moore (2011) provided suggestions for the range of formats that may appear in different PBL problems. Barrett et al. (2011) advocate creativity in problem formats, and describe several potential options for different presentation modalities (e.g., written narrative on paper, use of graphic images, audio narration, video animation, video recordings of persons or face-to-face interactions with real individuals). Since this study sought to explore the factors that optimize motivation, which is mediated in part by personal psychological connections, it was also important to consider if other aspects of social interaction between the problem and the learner are germane to the discussion.

Establishing social presence and community. In considering how to present a PBL problem to a student, it is useful to consider if any of the modalities described by Barrett, et al. (2012) (e.g., real persons, media, simulations) contribute to quality of the learning process via the importance or value assigned to the interaction. Social presence is a theory established by Short et al. (1976) that considers how intimacy (i.e., physical distance, body language, eye contact) or immediacy (i.e., being present) may add value or importance during interactions in instructional environments. Distance education is an area where social presence has received attention, given concerns that social interactions suffer in online learning environments (Kim, 2011). Hung, Flom, Manu and Mahmoud (2015) considered variations in social interaction in

their review of literature of instructional strategies intended to alleviate the problem of decreased social presence when receiving instruction in an online environment. Online or distance instructional environments by design, do not have the option for physical presence of the instructor and therefore alternatives to increase social presence are considered.

The strategies for developing social interaction described in the Hung et al. (2015) literature review may have applicability to the presentation format of subject in a PBL learning environment. In order to increase immediacy and intimacy, two dimensions of the psychological construct of social presence, group interactions need to have exchanges of information (Hung et al., 2015). Instructional strategies identified in online learning environments, which facilitate the intimacy and immediacy aspects among students for the psychological construct of social presence between students and content include: instruction provided with verbal presentation (i.e., audio emails, audio conferencing), non-verbal presentation (i.e., video conferencing), collaborative learning, debates, and discussions (Hung et al., 2015). Instructional strategies identified to support psychological constructs of connectedness also included collaborative learning activities designed to foster a psychological aspect of caring and concern for other students (Hung et al., 2015). Working around a common goal, in a meaningful activity, also provided a connection for applicability of content to the real world (Hung et al., 2015). These findings are also relevant to the PBL design process, as they inform us of potential ways to operationalize different levels of the variable of subject presentation for this proposed study.

Using lived experiences and real persons. Barrett et al. (2011) suggested different formats of problems in PBL be classified as lived experiences, simulated experiences, and/or digitized experiences. The description of lived experiences provided by Barrett et al. (2011), includes bodily experiences, social, and emotional experiences. One level of this study's subject

presentation type variable is consistent with this description: Level 4 - a real subject who is actually involved in the problem case and present during the scenario presentation (PBL Problem 4). Dammers, Spencer, and Thomas (2001) explored the possibility of whether or not using a real patient in a PBL learning environment would add value for the student learning experience. Their survey of 69 students in an undergraduate medical curriculum, following completion of a seven week PBL experience with access and interaction with real patients, resulted in an overwhelmingly positive response (i.e., 66/69) for the use of real patients and the value it provided in the PBL learning process.

Advantages of using a real patient from their analysis of student comments included the following categories: contextualization, interest and motivation, focus, responsibility, opportunities to clarify and verify data, different perspectives, empathy and patient-centered perspective, and meeting and talking with people. Dammers et al. (2001) interpreted the results of the students' comments as strong support for using real patients in PBL, as it aligned with aims of effective learning (e.g., stimulate interest, develop critical thinking) and created a context that was motivating, relevant, and genuine. They also asserted the development of a patient-student relationship fosters student responsibility and commitment, which is necessary when seeking information for complex cases of real life and steers students from seeking the answers from the facilitator, since it is clear the case was not manufactured by the instructor.

As an alternative to using a real person, without sacrificing authenticity of the nature of the PBL problem, a study by Yoon et al. (2016) explored using standardized patients (i.e., live persons trained to role play as a patient). Their medical school transitioned from a PBL curriculum that previously was using video cases for PBL problems to a PBL curriculum using standardized patients. They evaluated student learning experiences of 99 Korean medical

students via a questionnaire comparing the experiences with PBL cases provided via video cases with experiences with PBL cases using standardized patients. Yoon et al. (2016) concluded using a standardized patient was more effective than using video cases. Students reported the standardized patients created increased authenticity of the case, improved professional attitudes about the patient, and improved motivation, reflective thinking, and collaboration (Yoon et al., 2016). Yoon et al. (2016) hypothesized the ability to properly identify clinical aspects of a problem may be different if the PBL problem is presented in an actual face-to-face interaction as compared to alternative presentation formats (e.g., paper, audiotapes, video recordings, computer software). A potential disadvantage identified by the authors of this study included higher costs associated with standardized patients because of training needs, although the elimination of the ethical issues that must be addressed when actual patients are used in PBL (i.e., patient privacy), is a potential advantage (Yoon et al., 2016).

Another advantage of video presentation was the ability to "preserve original language and nonverbal information, and avoid depersonalization of the patients" (Yoon et al., 2016, p. 170). Although video by nature is more structured, there was concern it could lead to increased levels of passiveness. The students also indicated a preference for using the problem presentation type with face-to-face interaction (i.e., standardized patients). The largest margins of difference between standardized patient PBL and video-based PBL were in authenticity, patient-doctor communication, and developing an attitude toward patient (i.e., sympathy and responsibility). Yoon et al. (2016) concluded authenticity is established at the highest level through the interaction with standardized patients and the use of standardized patients created a "stronger motivation to learn than video cases" (p. 174). A significant limitation noted by the authors is the study did not control for the potential effect of problem content on the learning

experience. It is plausible some content areas may be better suited to different presentation formats. For example, a content area with strong emotional content (e.g., person with a terminal illness) could potentially create additional anxiety for a student using a standardized patient, whereas a video case may decrease the anxiety allowing for a student to focus more on the learning activities. The problem content areas for each of the PBL problems of the Yoon et al. (2016) study also occurred at different points in time (i.e., across two years), creating the potential for other confounding variables to have contributed to the perceived benefits of using standardized patients. The study, along with the conclusions of Dammers et al. (2001), does however, lend support for considering alternatives to a presentation format using face-to-face interaction. In both Yoon et al. (2016) and Dammers et al. (2001) the use of real people was perceived as beneficial for the study participants, including the ability to create a significant relationship with emotional connection to the patient subjects of the PBL problems.

Using media or digitized experiences in PBL. Barrett et al. (2011) categorized media as consisting of more than the video cases described by Yoon et al. (2016). Suggested formats include photographs, illustrations, websites, animations, videos, audio-clip, and partial concept maps (Barret et al., 2011). This description aligns with the following level of the subject presentation type variable for this study: Level 3 – a real subject who is actually involved in the problem case and presented to students in scenario presentation through an audio-visual media format (PBL Problem 3). A media modality still affords a problem designer the ability to design a problem around a real person (i.e., establishing authenticity), yet does not require a physical subject presence for scenario presentation of the problem. It does provide the opportunity to create the intimacy aspect of social presence through the visual and auditory information that can be provided from facial expressions, the tone of voice, or body language.

Balslev, De Grave, Muijtjens, and Scherpbier (2005) considered the influence of media for problem presentation in their study comparing text and video cases as a PBL presentation format for pediatric residents at Arhus University in Denmark. These students were observed during two cases with identical PBL problems, presented in the two formats. The number of and types of their verbal interactions were analyzed. Balslev et al. (2005) concluded there was a higher level of data exploration, theory building, and theory evaluation for the case presented via video, as compared to the case presented via paper, based on a higher frequency of complex verbal utterances (i.e., measured via clause complexity). Some students, however, demonstrated less difficulty with identifying the relevant aspects of the PBL tutorial process when using the text-based case. The authors concluded video was successful in stimulating students in cognitive tasks, resulted in longer engagement during analysis tasks, and provided support for an argument that multimedia learning may expand working memory by using the combination of visual and auditory information in a problem case. Given the very small study size (i.e., 11 participants), the strength of conclusions is quite limited. However, the study did demonstrate different levels of participation among the participants based on a media presentation format. An assumption of the conclusions by Balslev et al. (2005) is the activity and time spent in discussion tasks indirectly measures activation of cognitive processes and critical thinking.

In contrast to the findings from Balslev et al. (2005), Basu, Roy and McMahon (2012) questioned the value of video-based cases for deep critical thinking based on their analysis of student utterances during PBL implementations comparing a video-based and text-based PBL (i.e., paper case) presentation with a course for Harvard medical students. Although the majority of the students in the study designated video-cases as preferred to text-based cases, the qualitative analysis of their utterances during the PBL tutorial presented via video indicated a

decrease in critical thinking when compared with the text-based case. This finding raises an interesting question as to whether the interest in the format is the desired outcome. Basu Roy and McMahon (2012) suggested the video modality, although engaging and preferred, may be perceived as less demanding and lead to decreased mental effort or actually be distracting for the student. The authors summarized their concerns about cognitive load therapy in their statement: "The combination of auditory and visual data, and the greater emotional and psychosocial aspects that accompanied the video-based cases, may have inhibited the ability of students to formulate hypotheses and critically evaluate them" (Basu Roy & McMahan, p. 433).

Chen and Wang (2011) also considered the question of how presentation of instructional content in general affects student performance by examining whether or not there was a difference in learner emotions and performance based on how the instructional content was presented to the learners. In their study, they hypothesized there would be a significant relationship between how the instructional content is presented (i.e., multimedia type) and student emotional responses. Using human pulse signals to measure emotional states, Chen and Wang (2011) compared instructional modules presented to elementary school children as text materials with images and then compared emotional responses to instructional material presented as a video, or a video including an interaction aspect (e.g., animation). Although their study was limited in generalization beyond the context of their study, Chen and Wang (2011) found the video materials created more positive emotions and resulted in stronger outcome measures of learning than the written text or a simulated interactive module. They also found the greatest positive effects occurred when students were already in a positive emotional state, which is significant to the argument that the relationship between student emotions and learning is complex and multifaceted.

Chen and Sun (2012) expanded on the research of Chen and Wang (2011) by exploring the relationship between a learner's preferred cognitive learning style (e.g., visual, verbal) using multimedia presentation types, and using the rationale that one's emotional state affects learning. Using the same physiological instrument as Chen and Wang (2001), the *emWave* developed by *HeartMath*, the emotional states of learners (i.e., positive, peaceful, or negative) were monitored and compared among elementary students identified as having verbal or visual learning preferences. Chen and Sun (2012) concluded multimedia instructional materials presented via video provided the optimal learning performance for participants, regardless of whether the learning preference was verbal or visual. They also suggested their study supports the decision to use video with an interactive component (e.g., animation) as it provided an emotional response for students who had a visual learning style preference. Although neither study, Chen and Wang (2011) nor Chen and Sun (2012), claimed generalization to higher education or PBL, the studies do illustrate the potential value of video as an interface between content and learners, especially if building an emotional connection for learners is desired.

Using text-based (paper format) cases in PBL. PBL cases presented via a paper format were classified by Barrett et al. (2011) within a simulated experiences category including reports, texts, and correspondence. These formats are in addition to presentation formats that may be recognized more readily with simulation (i.e., written dialogue, dilemmas, role-play). Two levels of this study's subject presentation type variable were consistent with this format: Level 2 – a real person who was actually involved in the problem case and presented in scenario presentation through written text media (PBL Problem 2), and Level 1 – a fictional character from a case study scenario presented through written text media (PBL Problem 1). The advantages and disadvantages of presenting a PBL case using a written text (i.e., paper format) have also been

considered in other PBL implementations. Kenny and Beagan (2004) considered the value of using paper cases in a PBL learning environment by completing a narrative analysis of 10 PBL cases from an undergraduate medical curriculum at Dalhousie University. The concerns they raised about the use of a paper case for PBL included the potential for a paper case to decontextualize the information, and remove personal aspects of the patient and the physician from the problem. This is a concern because personal aspects that highlight the emotional nature of real patient scenarios help convey the "messiness of real patients' lives and emotions" (Kenny & Beagan, 2004, p. 1071). A written patient history provides information to the medical student, yet creates a detachment from the person as his/her voice and perspective are not presented authentically to the students.

The study authors also expressed concern with the use of passive voice as a common practice and the removal of the social and cultural context for the problem when the patient story is retold as a narrative description. The analyzed narratives also were interpreted as using the physician's voice, which may be interpreted as an authority figure, limiting curiosity and initiative in questioning by students as they engage in problem solving.

The study by Kenny and Began (2004) addressed the variation of a paper case using a fictional character. They raised concerns that a fictitious paper case may guide learners to a perspective that will also reduce the personal connection or attachment to the subject, which allows students to avoid the muddiness that a real situation embodies. The elimination of body language was specifically mentioned as a disadvantage, which would also align with the intimacy aspect of social presence. As a fictitious case, authenticity is eliminated, unless the students are not informed.

Poulton, Conradi, Kavia, Round and Hilton (2009) describe a transition occurring in the delivery of PBL cases in their medical school curriculum at St. George's University of London from paper cases to virtual patients via electronic media. Similar to the Kenny and Began study (2004), Poulton et al. (2009) challenged the benefit of using paper formats for PBL problem presentation stating it creates a "delivery of PBL that is linear and inflexible" (p. 752). Therefore, paper cases would be less useful for critical reasoning and depicting real-life scenarios. The basis for this assertion is not clearly explained, other than in using their alternative virtual presentation format, where different decision paths were embedded. However, one could argue that a paper case could afford a similar level of decision options if it were carefully constructed. In their survey of student perceptions for paper versus online presentations of PBL following a trial of both modalities, 32% agreed they found online PBL presentation more engaging than when using a paper case. However, 42% strongly agreed that it was difficult to not have a paper printout of the PBL case, suggesting some value to using a paper presentation of materials. With regard to their ability to meet learning objectives, 59% believed they were able to meet objectives with the online presentation. Reviews were mixed from tutor perceptions comparing their experiences using paper cases with a virtual environment, with three out of eight disagreeing with the statement that it was easier to tutor when using paper-based cases. Five out of eight tutors believed students were more engaged with the online cases. The conclusion from Poulton et al. (2009) was that student and tutor perceptions of using online presentation were favorable when compared to the use of a paper case. However, their study did not assess specific differences in cognitive learning outcomes between the two presentation modalities.

Thus far, the studies described have compared PBL presentation formats as a comparison of two different formats. In the final study of this literature review, each of the proposed levels for this study's presentation types was considered. Li et al. (2013) compared PBL learning outcomes for medical students enrolled in a Chinese dermatology course using three different presentation types of PBL (i.e., real-patient, digital, paper case) and also compared learning outcomes with a lecture-based dermatology course as a contrast to PBL. The same course content was provided in each condition and the 120 participants were randomized into each condition group. Student perceptions were evaluated using a Likert-type scale questionnaire to compare whether there was a difference in student perceptions among students and written and clinical assessment performance following the PBL module was compared. Performance on written assessments was higher for all three conditions of PBL as compared to the lecture presentation. However, there was not a significant difference between the three conditions of the PBL presentation. Similar findings were found for clinical assessments, with the PBL presentation outperforming the lecture presentation. For clinical assessments, the assessment scores for the real-person presentation and digital presentation were higher than the paper presentation at a statistically significant level. Clinical performance was rated higher for skills in problem solving, interaction/collaboration, and applying knowledge for the students in the real-person group as compared to the digital and paper presentation groups. Li et al. (2013) concluded the real patient presentation and the digital form of media presentation as beneficial for developing clinical skills. Also, they found the real patient presentation efficacious for cultivating self-directed learning and confidence for their future skills, and superior to both digital and paper cases overall. Student perceptions of the different PBL presentations

demonstrated a preference for real patients and digital media formats, as they "were considered to be more relevant to real-world clinical situations than paper cases" (Li et al., 2013, e967).

Summary

This literature review has described studies pertaining to the structure of PBL as an instructional approach, its characteristics, and effects on learning. An overview of the rationale for using PBL in SLP and relevant studies on outcomes when using PBL was also described, followed by potential challenges for using PBL, specifically related to problems with student fatigue and declining motivation in a challenging, active learning environment. A discussion of the potential opportunities for addressing these concerns through purposeful consideration of affective elements of PBL problems using the 2nd generation 3C3R PBL problem design model was outlined.

Within the literature pertaining to the structure and nature of PBL in general, there was a general consensus that PBL provides an engaging and interactive learning approach, more effective learner outcomes, and a positive student learning experience (Albanese & Mitchell, 1993; Barrows, 1986; Barrows & Tamblyn, 1980; Hmelo-Silver, 2004; Hmelo-Silver & Eberbach, 2012; Hung, 2009; Schmidt, 1983; Vernon & Blake, 1993). The full benefits as a learning approach, however, were described as being at risk when PBL was not fully implemented as intended or when student engagement declined (Czabanowska et al., 2012; Domans et al., 2001; Romito & Eckert, 2011; Moust et al, 2005). The PBL literature presented examples of various problem presentation formats, including some perceived benefits of using real patients to provide a context for applying information (Dammers, Spencer & Thomas, 2001; Hung et al., 2013; Li et al., 2013; Yoon et al., 2016), yet the studies did not specifically explore the variables of problem design or problem format in depth as the PBL experiences unfolded.

Yoon et al. (2016) for example, identified a difference between lecture presentations and PBL based on student preference, yet it was not clear what aspects of the PBL problem presentation modality or problem design features were contributing factors for that preference.

The specific PBL problem design process for PBL problems was vaguely described in the literature pertaining to international SLP PBL curriculum (McAllister et al., 2014; Mok, Dodd, & Whitehill, 2009; Whitehill et al., 2014), yet PBL problem design is considered an important aspect of PBL (Hung, 2016). Specifics were also lacking in the descriptions of domestic SLP PBL implementations (Burda & Hageman, 2015; Greenwald, 2006; Keegan et al., 2007a; Kong, 2014) with regard to the PBL problem design process. Comparing PBL problems using a consistently applied problem design approach may allow researchers to systematically compare the PBL presentation modalities, and understand the potential benefits of using real subjects and affective problem elements with more legitimacy than has been described in the existing literature.

The literature also provides examples of PBL gaining acceptance in the professional discipline of Speech Language Pathology internationally (McAllister et al., 2014; Mok et al., 2008; 2009; Whitehill et al., 2014) as a curriculum and domestically in a modest number of graduate-level courses (Burda & Hageman, 2015; Greenwald, 2006; Kong, 2014) and undergraduate courses (Keegan et al., 2017a, Visconti, 2010). The descriptions in the SLP literature, with the exception of Kong (2014) and Keegan et al. (2017a), did not specifically consider the relevance of involving real patients, or whether some SLP content areas or affective aspects of PBL problems are linked to actual changes in engagement.

The SLP implementations described in the literature also have not explored content mastery as specifically as it has been discussed in the PBL literature for medicine (Albanese &

Mitchell, 1993; Dochy et al., 2003; Vernon & Blake, 1993). The PBL literature specific to SLP is also lacking in specific comparisons between problem formats to address threats PBL effectiveness, which included PBL fatigue (Czabanowska et al., 2012) and an erosion of the fidelity of PBL (Moust et al, 2005). One may argue it will be difficult to expand PBL or use real problem subjects within SLP contexts without more examples providing support from the student perspective or evidence of the impact of PBL problem design on student engagement. In conclusion, the literature described in this review informed the rationale for the study purpose, the study design, and the development of operational definitions for the variables of subject presentation type and motivation. In the next chapter, the research methodology for this study is provided in detail.

CHAPTER III

METHODS

The purpose of this mixed-methods study was to: (1) evaluate and explain the impact of using different subject presentation types in the problem design process on student motivation as measured by levels of student engagement when using the PBL instructional approach, (2) identify how other factors (e.g., personal or career interest) affected student motivation during PBL instruction from the perspective of students as they engaged in the PBL process, and (3) identify the impact on content mastery for Speech and Voice Science. A parallel convergent mixed method design is a type of mixed methods research design that collects and analyzes quantitative data and qualitative data to compare different perspectives for understanding a research question and embed triangulation within the research design (Creswell, 2013; 2014; 2015). Creswell (2013) describes the use of mixed method as one way to bridge the limitations of quantitative and qualitative methods that exist when used alone. It is especially useful for problems that are not explained fully by one method or the other. Appropriate reasons for using a mixed methods approach include: desire or need for various perspectives, confirming quantitative findings with qualitative support, and providing a context for quantitative results (Creswell, 2013; 2014). The quantitative methods in this study used data from observed behaviors of student engagement that were collected and analyzed using a quasi-experimental, within-subjects design. All study participants experienced each of the PBL problems within the duration of this study. The subsequent variations in observable engagement behaviors measuring motivation were not compared to a control group, a necessary element in a true experimental

design; rather, they were used to compare different subject presentation types across four PBL problems.

The study's independent variable for the quantitative part of this study was subject presentation type. This variable was operationalized by levels of authenticity (i.e., real versus fictional) and social presence via varied presentation format modalities (i.e., written text, audio/visual, and face-to-face interaction), creating four levels of subject presence. The dependent variable, student motivation, was measured and operationalized via levels of observable, verbal and nonverbal behaviors of engagement. Classroom observers (i.e., research assistants) who were blind to the study purpose and research hypotheses, recorded the frequency of student behaviors of engagement during each of four PBL problems developed for this study.

The qualitative data collection of this study occurred simultaneously with the quantitative data collection and the analysis was used to triangulate the research findings. Qualitative data analysis of student learning artifacts (i.e., narrative reflection journals, assignments) and field notes provided the source data for the development of qualitative codes and descriptive themes (Creswell, 2013; 2016). See Figure 1. for an overview of the study design and Figure 2. for an overview of the 2nd generation 3C3R problem design model, which guided the development of the PBL problems that provided the context for the following research questions.

Study Research Questions

1. (Quantitative) How does the subject presentation type of problem scenario (e.g., a real subject who is involved in the problem case) within a PBL problem scenario affect student motivation measured by levels of student engagement during the PBL instructional process?

a. Hypothesis: Student motivation measured by engagement level will be the highest when working on a problem presented by a real person who is involved with the problem (i.e., Level 4, PBL Problem 4).
b. Hypothesis: There are significantly different levels of observable engagement behaviors for the different subject presentation types of the problem scenario.
    i. *Level 1, Fictional subject, text*: a fictional subject character and problem presented using written text case description (PBL Problem 1)
    ii. *Level 2, Real subject*, *text*: a real subject and problem presented using written text case description (PBL Problem 2)
    iii. *Level 3, Real subject, audio-visual*: a real subject and problem presented using video and audio elements (PBL Problem 3)
    iv. *Level 4, Real subject, face-to-face*: a real subject and clinic problem presented in a face-to-face classroom interaction (PBL Problem 4)

2. (Qualitative) How does one's career interest, personal connection/interest, or prior experience with subject problem content area, or other factors affect student motivation and engagement when participating in a course using PBL?
3. (Quantitative) Does PBL provide an effective instructional method for content mastery for Speech Science learning outcomes within a Speech, Language and Hearing Sciences undergraduate course?

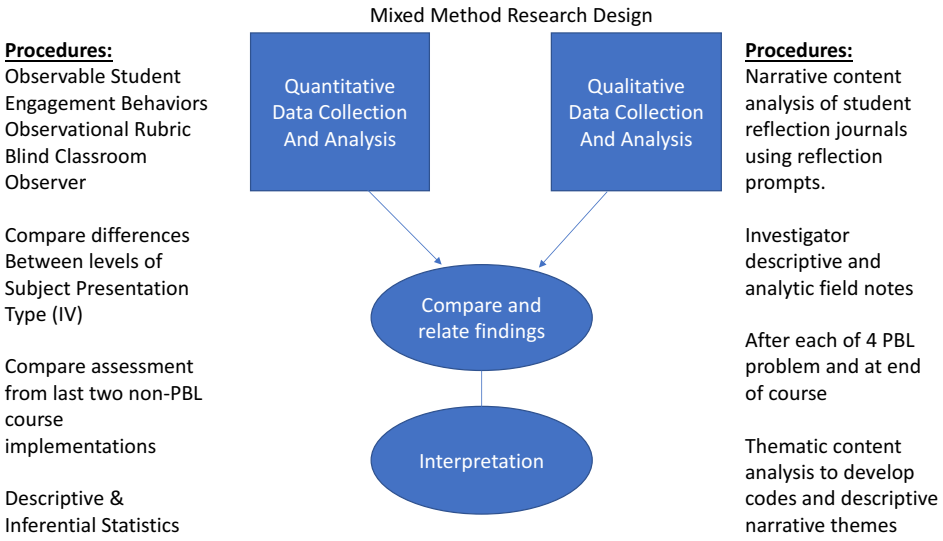

Figure 1. Mixed Methods Study Design Overview.

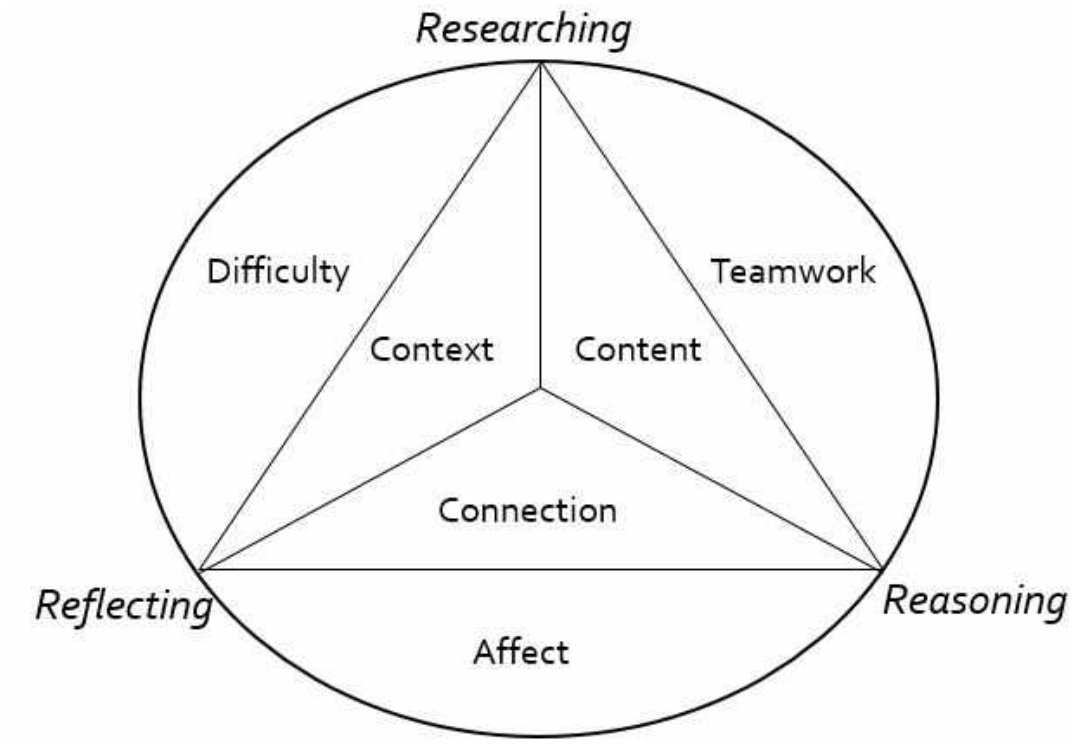

Figure 2. Graphic representation of 2nd generation 3C3R Problem Design Model (Hung, in press). To appear in M. Moallem, W. Hung, & N. Dabbagh (Eds.), *The Wiley Handbook of Problem-based Learning*. Boston: Wiley.

Study Setting

The setting for this study was two undergraduate Speech and Voice Science (SLHS 421) course sections at a Midwestern, four-year university during the 2017 spring semester. The SLHS 421 course was one of the investigator's teaching responsibilities as a faculty member. The course syllabus and schedule are provided in Appendix A. In five of the last six years of the investigator's experience with teaching SLHS 421 prior to using PBL methods, this course was taught using a traditional lecture style format with content provided primarily from the instructor and published textbook content (i.e., instructor-centered). A PBL teaching format was piloted during the 2016 spring semester to provide the instructor experience with PBL and reduce potential threats to validity related to instructor inexperience with PBL. Although the Speech and Voice Science (SLHS 421) course was selected for this study in part because of its accessibility to the researcher, it is also provided an example of a course with student learning goals related to foundational domain knowledge and concepts (e.g., phonation, respiration, acoustic analysis of voice and speech), which provide groundwork for future courses in graduate level training in the professional disciplines of speech language pathology and audiology. This study setting provided an opportunity to evaluate a PBL implementation while contributing to the limited amount of PBL literature specific to the discipline of Speech Language Pathology (also referred to as Communication Sciences and Disorders and/or Speech, Language, and Hearing Sciences) at the undergraduate level in the United States.

Study Participants

The participants for this study were the students enrolled in SLHS 421 during the 2017 spring semester. Forty-six female students were enrolled in two sections of SLHS 421, each with 23 students. Most students were in their final semester as this is typically a senior level course

for students completing their undergraduate major in Speech, Language, and Hearing Sciences at the university. All students in the course were either seeking an undergraduate degree in speech, language, and hearing sciences or completing a post-baccalaureate sequence, which is a pathway for future graduate school training in speech language pathology or audiology. Students were provided with a written informed consent statement per approved institutional IRB protocol at the start of the course as an addendum to their syllabus (See Appendix C), which described the purpose of the study as exploring using Problem Based Learning (PBL) as an instructional approach within the discipline of Speech, Language, and Hearing Sciences curriculum. Students were asked to self-identify their prior experience with PBL to address a potential confounding variable of student experience with PBL on proposed dependent variable of motivation. No students had prior experience with PBL as an instructional format.

There was a lack of diversity for gender in this study's sample. The ratio of male to female students in SLHS courses at this university were highly skewed to female gender. A high ratio of female to male is also typical of the SLP profession. The study did not use gender or ethnicity as a study variable given the anticipated homogeneity of the sample. The study investigator taught the course with the assistance of three SLP graduate student(s) working in the capacity as paid, research assistants for data collection.

PBL Problem Scenarios

The primary variable of interest (i.e., subject presentation type) was implemented in this study via four PBL problem scenarios developed using the 2nd generation 3C3R problem design model (Hung, in press, 2009, 2016). This model provided the conceptual framework for the problem design and implementation of PBL in this course. The 2nd generation 3C3R problem design model provides a guide when creating PBL problems for content and cognitive processing. The

model also provides a guide for enhancing motivation and engagement in the PBL problem through focus on psychological connections, social interactions, and subject authenticity (See Figure 2.).

Each problem scenario represented a different level of the study's independent variable (i.e., subject presentation type) and each level indicated an increasing amount of social presence intended to enhance the student's awareness of the authenticity of the problem scenario and potentially maintain or trigger motivation during the PBL problem modules and throughout the course (See Table 1).

Table 1. *Summary of PBL Problem Modules by Levels of Subject Presentation Type*

PBL Problem	Content/Domain Knowledge	Subject Presence Level	Problem Difficulty	Social Presence	Problem Description
#1	Speech Breathing	Level 1: Fictional (text)	Moderate	Low	Adapted Textbook Case Study Speech Breathing
#2	Phonation	Level 2: Real subject (text)	Moderate	Low	Real Client Voice Disorder
#3	Speech Acoustics	Level 3: Real subject (audio-visual)	Difficult	Moderate	Real Client Accent Modification
#4	Instrumentation for acoustic analysis	Level 4: Real subject (Face-to-face)	Difficult	High	Real Individual SLHS Clinic Director

Presenting a problem scenario via a written, text description to the students represented a low level of social presence as compared to the subject of the problem scenario with a real person (i.e., not fictionalized), who was physically present in the classroom during the problem presentation and able to interact and engage with students. A summary of problem scenario

topic areas and the progression of operationalization for the levels subject presentation type variable is shown in Figure 3.

	Independent Variable	Dependent Variable		
What will be tested?	*Subject Presentation Type*	What will be measured?	*Motivation*	
PBL Problems* *Designed using 2nd generation 3C3R Problem Design Framework (Hung, in press)	Subject presentation Type: 4 Levels	In-Classroom Observation Rubric (Quantitative)	Student Refection Journal (Qualitative)	Field Notes from Facilitator (Qualitative)
PBL Problem 4	Subject presence Level 4: real person(s) (who is(are) actually involved in the problem case) present in scenario presentation through face to face interaction			
PBL Problem 3	Subject presence Level 3: real person(s) (who is(are) actually involved in the problem case) present in scenario presentation through media (video or audio)			
PBL Problem 2	Subject presence Level 2: real person(s) (who is(are) actually involved in the problem case) present in scenario presentation through media (text)			
PBL Problem 1	Subject presence Level 1: Fictional subject (similar age of study participants) media (text)			

Figure 3. Overview of Study Methods Describing the Relationship between the Study Variables and the Data Collection Methods.

PBL Problem 1. PBL Problem 1 represented Level 1 of the subject presentation type independent variable, a fictional subject with the lowest level of social presence (i.e., a written text presentation). The context of the domain knowledge represented in this problem focused on respiratory system domain knowledge as it related to the course learning objectives for the relationship of breathing for voice and speech production. This problem scenario was adapted from a textbook case study (Hixon, Weismer, & Hoit, 2014) describing a 19-year-old college student who is paralyzed because of a cervical-spinal injury and faces the dilemma of whether she will be able to control a service animal using her voice. The subject presentation type level

was fictional; however, the age and gender of the subject were comparable to the students enrolled in SLHS 421, and was intended to contribute to the affective connection between the students and the PBL problem (i.e., enhancing aspect of 2nd generation 3C3R). It was anticipated this aspect of the problem design might potentially trigger the relatedness aspect of the self-determination theory (Ryan and Deci, 2000) to influence motivation.

PBL problem 2. PBL Problem 2 represented Level 2 of the subject presentation type independent variable and was developed from an authentic client case (i.e., a real person involved in the problem case) as a subject with the scenario presentation delivered through media (i.e., text). The context of the domain knowledge represented in this problem focused on phonatory system domain knowledge as it related to the course learning objectives for anatomical and physiological bases for voice production. The difference between Level 1 and this level was the transition from a fictional case to an authentic problem scenario based on recent events (i.e., temporal proximity) and a familiar location (i.e., location proximity). This PBL problem used a text description of a real client who received voice therapy in the university clinic affiliated with the undergraduate program that served as the setting for this study. The subject and nature of this clinical problem are within the scope of practice for SLPs, which was hypothesized to enhance the affective component of the problem and create a potential relationship between a students' career or personal interest. The age of the client was also comparable to the students in SLHS 421 and her voice issues were threatening her ability to pursue her desired occupational goal, which was intended to be relatable to the career aspirations of the study participants. Both aspects were guided by the affective aspect of the conceptual framework (i.e., 2nd generation 3C3R) during the PBL problem development and were

anticipated to influence the relatedness, and therefore motivation for engagement between the students and the problem.

PBL Problem 3. PBL Problem 3 represented Level 3 of the subject presentation type independent variable, a real subject, involved in the problem case presented to the students through the use of audio-visual media. This problem, like the previous one, provided the students with an authentic problem with a real university clinic client, however, the subject presentation type shifted from text to include visual and auditory components (i.e., video and audio from a therapy session). This aspect of the subject presentation type was hypothesized to represent a higher degree of authenticity and social presence for the students during the problem development during affordance analysis component of the 2nd generation 3C3R problem design model. The subject of this PBL problem received accent modification therapy secondary to using English as a second language, however, progress with traditional speech articulation strategies had plateaued and the problem addressed whether or not acoustic analysis of speech would be an appropriate therapeutic option to traditional phonetic approaches. His therapy addressed a communication barrier (i.e., reduced intelligibility of speech), which prevented the client from performing a key aspect of his profession, which was intended to trigger an emotional relationship with the problem subject. This problem personified a speech difference and not a clinical disorder. The problem statement asked the question of whether or not speech acoustic knowledge could inform clinical practice for accent modification strategies. The context of the domain knowledge (i.e., speech and voice acoustics) increased the problem difficulty from moderate to difficult when compared to the previous two PBL problems. Contributing to the difficulty of this problem was expectation that student prior knowledge would be limited and the perceived difficulty of domain concepts, based on the results of the

problem affordance analysis using the 2nd generation 3C3R problem design model and the prior experience of the investigator in teaching these concepts.

The domain content of PBL Problem 3 focused on the acoustic characteristics of vowels and consonants, production of speech sounds in context (i.e., coarticulation, intonation, stress, duration), the acoustic theory of speech production, and the use of spectrography for acoustic analysis. By using visual and auditory media the scenario was expected to provide additional sensory information (i.e., visual cues, auditory cues) about the person's speech production characteristics, which were not presented in the prior two subject presentation levels (i.e., text), thus building on a potential personal psychological connection with a more direct social presence. In addition, this problem required students to contribute to future treatment planning recommendations for a client in a familiar setting, which also was intended to trigger their connection a future career interest (i.e., graduate students providing therapy) and ideally enhance relatedness necessary for motivation to fully engage in PBL.

PBL Problem 4. PBL Problem 4 corresponded to Level 4 of the subject presentation type independent variable and was presented to the students in a face-to-face interaction by the individual who was the subject of the problem scenario. The person presenting this final PBL problem was the clinic director at the university's on-campus speech, language, and hearing clinic. Students in SLHS 421 were familiar with this person from observations completed in prior courses and the clinic setting was representative of where students can expect to work if they are accepted into graduate school, which is an aspiration of many students enrolled in the course. This subject presentation level was intended to enhance the authenticity of the problem by providing the highest degree of social presence (i.e., face-to-face interaction) and was intended to trigger motivation by emphasizing the practical utility of recommending solutions

that would be implemented by the clinic based on student's expertise in the course content of SLHS 421. In other words, their solutions were intended to provide immediate value (i.e., immediacy) to the subject presenting their problem (i.e., clinic director), and would be directly applied to clients receiving clinic services and benefit future SLHS 421 students, thus emphasizing the relatedness aspect of motivation and maximizing social presence. Having a person available to the students for interaction and questions during the presentation of the problem scenario and also as a person to directly report their findings from their research was intended to reinforce their motivation for engaging at a high level by using direct social interactions. This problem was purposely presented last and at the point in the semester. It was anticipated that student fatigue and interest in full engagement with PBL could possibly diminish at this point (i.e., the last of four consecutive PBL problem modules).

The context of the domain knowledge represented in PBL Problem 4 required students to access a combination of content knowledge from prior problems to evaluate and recommend instrumentation options for the analysis of speech and voice characteristics. This problem required students to synthesize their knowledge, and make recommendations based on a cost benefit analysis. They also were advised to review the evidence-based practice (EBP) for the different types of currently available acoustic measurement instrumentation (e.g., software, hardware, mobile devices) for the analysis of speech and voice parameters to provide a suitable recommendation for clients who are currently seen in the speech, language, and hearing science clinic. The choice of appropriate instrumentation required a significant financial investment for the clinic. The multiple instrumentation options available via freeware and smart phone applications for capturing and analyzing voice and speech characteristics created the potential for a varied solution to this problem and enhanced complexity. The clinic needed to insure the

instrumentation used in the clinic met the needs of the clinic patients, the graduate student clinicians, and was compatible with budgetary and operational constraints. Students needed to justify their recommendations with scientific evidence for measuring speech and voice parameters for analysis of speech and voice. This final problem, like the previous one, represented a high level of PBL difficulty as it required students to synthesize information from previous problem modules and engage in new research, in addition to completing evaluative tasks (i.e., identify and support recommendations based on evidence and rationale). A visual representation of the sequence of PBL problems previously described as they were presented to the students is presented in Figure 4.

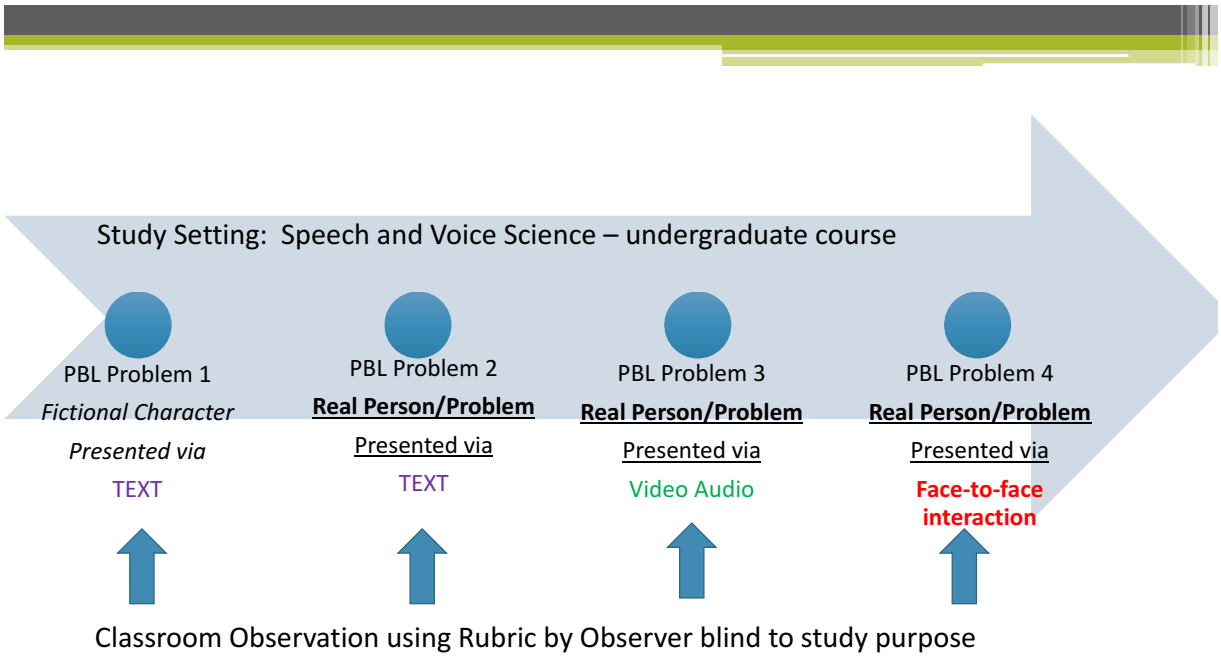

Figure 4. PBL Problem Order and Relationship to Subject Presentation Type.

Each of the four PBL problems for this study were designed to provide a meaningful, realistic context for students and to align with course learning objectives using the 2nd generation 3C3R problem design model, with purposeful design decisions to maximize the enhancing aspect of the conceptual framework. Each level of subject presentation type variable was intended to

scaffold the degree of social presence (Short et al., 1976) and problem authenticity (Hung, 2015) for the instructional environment to foster relatedness and connection during the learning process as the difficulty of the problems and the potential for PBL fatigue increased.

Instruments

This study used multiple data collection methods to support the quantitative and qualitative aspects of this study. Data was obtained using classroom observations, document review of student reflection journals, investigator field notes, and current and prior course assessment data.

Observation rubric. Data for the dependent variable motivation, was collected by observing the frequency of student verbal and nonverbal engagement behaviors using a classroom observation rubric adapted from a review of existing engagement inventories by the study investigator. The developed classroom observation rubric was modeled on an instrument developed by O'Mally, et al. (2003) for measuring student engagement in medical schools (i.e., STROBE). The STROBE tool was developed to provide direct observation of behaviors associated with engagement in 5-minute intervals, analogous to the manner in which a strobe light will activate in even intervals. The direct observation tool used the rationale that direct observation is preferred and more accurate than self-report measures. Observational periods of 15 minutes, rather than 5 were used for this study as the developers of the STROBE instrument suggested one limitation of the instrument was that the short time frame may make the data collection process clumsy and difficult to manage. This observation rubric provided quantitative data consisting of frequency counts and qualitative comments from the research assistant (i.e., classroom observer) during scheduled classroom observations during each PBL problem module for a combination of verbal and non-verbal engagement behaviors.

Verbal engagement behavior categories were as follows: questioning, confirming, general commenting (on and off topic), specific commenting on personal experience or prior knowledge, suggesting items for an action plan and/or verbal directive, and reading aloud to share knowledge. The nonverbal engagement behaviors were: listening (eye on speaker or contemplating), reading or researching (via written text or electronic media), organizing action (i.e., writing on white board to organize or using graphic organizer/shared document), and writing notes. The observation rubric also allowed observer to include narrative, observational comments and provided a space for a subjective judgment of the overall impression of the number of students engaging in on-task behaviors (i.e., all group members, all except one, more than half or half or less).

The observation rubric was piloted during the practice PBL problem and training phase for research assistants. The classroom observers were familiar to the students as assigned teaching assistants and graduate students in the department. Therefore, their presence in the classroom was not anticipated to be discerning to the students. The research assistants were trained on the use of the data collection instrument (i.e., observation rubric) prior to the start of the study. Redundant data collection by the research assistants using the observation rubric occurred during the practice PBL modules to collect inter-rater reliability measures for the observation rubric. Discrepancies between the observers were discussed in debriefing sessions after PBL session during the training phase to reconcile the difference and clarify operational definitions. Minor modifications to categories were implemented after debriefing sessions and a review of the reliability between observers. The two primary observers rotated between each course section to decrease observation bias. A third back-up observer was trained during PBL problem one by completing simultaneous observations with each of the two primary observers in

case one of the two primary research assistants was absent. The back-up observer was needed for data collection during one day of data collection during PBL Problem 4. The final version of the observation rubric is found in Appendix B.

Observers positioned themselves in the center of the room and moved their chairs closer to the group they were observing during the appropriate time intervals to provide improved visual line of sight and the ability to listen to group discussions. The observation rubric was used in the first three of four total PBL sessions of each problem module, resulting in a total of 12 classroom observations sessions for each course section. Since students reported their problem recommendations to the entire class during the fourth PBL session, data was not collected during this class period. During each of the 12 classroom observation sessions, each PBL group was observed for a total of 15 minutes without the course instructor (i.e., investigator) present to minimize influencing engagement behaviors. The order of group observations rotated systematically throughout the study to minimize the potential effect of time-period of the observation of student engagement behaviors. For example, the first 15 minutes may result in a different level of engagement than the last 15 minutes of a class session and therefore the observation order was rotated each day of data collection.

Student reflections. At the end of each of the four PBL problem modules and again at the end of the course (i.e., five total written reflections), students generated written reflection journal course assignments. These assignments provided students an opportunity to demonstrate their mastery of content objectives, reflect on their use of metacognitive problem-solving strategies in their learning experience, and discuss factors influencing their engagement and/or motivation. These assignments served as additional sources of qualitative data providing a means for further explanation of the analysis of the quantitative observed engagement behaviors data

from the classroom observation rubric. Essays were assessed for elements of content mastery, organization, depth, and writing mechanics during the course implementation for grading purposes, and then re-analyzed at the end of the course using narrative content analysis to identify recurring themes and categories relevant to the research questions pertaining to engagement, career interest, personal connection to the problem, content mastery, and overall learning experience.

The following prompts were used for each narrative journal assignment (i.e. 400-600 word written essay): 1) Review the learning objectives from this module and discuss a goal which you believe was clearly met and describe what you have learned; 2) Which aspects of the PBL problem scenario or associated PBL tasks have impacted (or have not impacted) your learning experience? Consider what aspects of the problem affected your motivation to engage with your peers, instructor, or the content during this module; and, 3) Reflect on whether or not there are any aspects of this PBL problem which aligned with your own personal interest, prior experience, or career interest. Discuss how it influenced (or did not influence) your learning experience. These prompts were consistent across the four problems. At the end of the course, the prompts were amended to refer to the entire PBL experience.

Facilitator field notes. The final qualitative data element was provided by descriptive and analytical field notes created by the PBL facilitator (i.e., investigator) during the course to capture relevant observations pertaining to engagement or other related occurrences. These field notes provided the perspective of the investigator on engagement during the course. The qualitative data combined with investigator field notes provided additional voices to explain the quantitative results. A summary of the relationships between the data collection instruments and research questions is shown in Table 2.

Table 2. *Relationship Between Research Questions and Data Collection Instruments*

	Quantitative*		Qualitative	
	Engagement Behavior Observation Instrument	**Course Assessment Data**	**Student Reflection Journals**	**Investigator Field Notes**
Research Question 1: How does the subject presentation type (e.g., a real person who is actually involved in an authentic problem) within a PBL problem scenario affect student motivation measured by levels of student engagement during the PBL instructional process?				
***Hypothesis 1.1**: Student motivation measured by engagement level will be the highest when working on a problem presented in a face-to-face interaction by a person who is actually involved with the problem .	√		√	√
***Hypothesis 1.2:** There are different levels of observable engagement behaviors for the different subject presentation types of the problem scenario	√			
Research Question 2: How does one's career interest, personal connection/interest, or prior experience with subject problem content area affect student motivation and engagement when participating in a PBL course?				
			√	√
Research Question 3: Does PBL provide an effective instructional method for content mastery for Speech Science learning outcomes within a Speech, Language and Hearing Sciences undergraduate course?				
		√	√	√

Note: *Hypothesis statements only pertain to quantitative research question 1

Study Implementation Procedures. The study was completed during the 2017 spring semester during the course offerings for the undergraduate course, SLHS 421 (Speech and Voice

Science). Four problem scenarios representing major domain knowledge areas were developed using Hung's (in press) 2nd generation 3C3R problem design model. Forty-six students across two sections of SLHS 421 (23 students per section) were enrolled, creating eight PBL groups. Six of the groups had six students and two of the groups had five students. Students were randomly assigned to PBL groups and the same group was maintained throughout the study. The problems for the practice PBL module and the first and second PBL modules were piloted during the Spring 2016 SLHS 421 course taught by this investigator.

Institutional Review Board (IRB) approval was obtained from participating universities prior to the start of the study. Students enrolled in SLHS 421 were provided with a written informed consent statement at the start of the course as an addendum to their syllabus (See Appendix C), which described the purpose of the study as exploring using Problem Based Learning (PBL) as an instructional approach within the discipline of Speech, Language, and Hearing Sciences curriculum. The non-participant observers were paid graduate research assistants who completed Family Educational Rights and Privacy Act (FERPA) and IRB training prior to the start of the study. The graduate research assistants were aware they were collecting data on engagement behaviors as indicated by the data collection instrument categories, however, they were blind to the specific purpose of the study and research questions. Students were also aware the study pertained to PBL per the informed consent statement, however, they were not provided with the specific research questions or hypotheses.

The first two weeks of the semester served as a course introduction, a review of pre-requisite content on basic acoustics, and an overview of problem-based learning. The PBL practice module and piloting of the observation instrument occurred during weeks three and four of the semester. The practice module also afforded the students in SLHS 421 an opportunity to

practice skills central to a PBL instructional method: collaboration strategies, hypothesis generation, and engagement with research resources. The initial practice module also provided group members with an opportunity to practice active learning options for a course requirement of creating a learning artifact for each problem (i.e., concept mapping, graphic organizers). Students also practiced using and rotating the assigned PBL roles as they engaged in PBL research and teaching activities. In the practice phase, the PBL facilitator (i.e., investigator) provided a high level of support as the students practiced the steps of PBL and provided ongoing education on the rationale for the PBL instruction method. This high level of support prior to the introduction of the PBL problems representing the different conditions of the subject presentation type variable was intended to minimize the potential effect of unfamiliarity with the PBL method. It also was intended to reduce potential anxiety associated with using different instructional approach.

Implementation of data collection for engagement began in week five of the semester. Each PBL module lasted for four class periods over a two-week period (i.e., 75 minutes per for each class session, 300 minutes per PBL module). Students presented their group recommendations to the problem scenario during the fourth and final meeting of the PBL module. After each PBL module, students completed their individual reflection journal assignments in response to questions about their content mastery, learning experience, and reflections on engagement during the module. Content assessments (factual knowledge) in the form of online quizzes were completed after the first three PBL problems for comparison to previous assessment data from prior offerings of SLHS 421 (i.e., non-PBL instructional format). A final exam for factual knowledge content from PBL Problem 3 and PBL Problem 4 was also

administered for comparison with exams from two prior non-PBL years. This provided a measure for content mastery of course learning outcomes and objectives.

PBL Problem Module Procedures. At the start of the each PBL module, each student assumed a designated role, which rotated after each group meeting. The group member roles (Duch, 2001) were as follows: discussion leader, recorder or note taker, time keeper; observer/quality control; and up to two as observers/quality control. See Appendix A for a description of the role descriptions for use in PBL from the course syllabus as suggested by Duch (2001). During the first group meeting, when the problem was presented, the groups engaged in brainstorming sessions to discuss what they already knew and establish what they needed to learn to address the problem scenario (i.e., develop learning objectives). The students then assigned each other research tasks to be completed before the next class session. The PBL facilitator (i.e., investigator) met with each group for approximately 15-20 minutes on a rotating basis during each class session to provide feedback to the students on their decision making and learning objectives, model problem solving strategies, and support students during the learning process by asking questions and guiding to resources when necessary.

Outside of class, students were expected to complete their assigned research tasks and report their findings to their group members at the start of the next session. Each group then repeated the cycle of discussing what they already knew, generating new or revised questions and/or research tasks, as indicated in a PBL learning approach. Each group was also required to generate a learning artifact of their choice (e.g., concept map, graphic organizer, shared collaborative document) as a course assignment on a learning objective their group had identified. On the final class session for each PBL module, each group presented their response to the problem scenario and shared their group's learning artifact (e.g., power point, concept

map, graphic organizer) with their peers. During the final PBL problem module, the subject of the problem scenario was physically present in classroom for the problem scenario recommendation presentation and was also present for the final group problem recommendations, thus fulfilling the operational definition of the PBL Problem Level 4 for subject presentation type variable (i.e., real subject, face-to-face interaction).

Data Collection Procedures

Data was collected using the following three methods previously described: classroom observation (non-participant observer), written narrative journal assignments, and content assessments. The non-participant observation provided the quantitative data of the mixed methods research design. Using the observation rubric instrument (See Appendix B) the observer recorded the frequency of different engagement behaviors during the three initial PBL group meetings for each PBL problem, providing the data for later comparison with the different subject presence levels of the independent variable of subject presentation type for each PBL module. During the three days of data collection during the data instrument pilot (i.e., practice PBL module), two research assistants collected data simultaneously. A comparison of the data collected after day one of the pilot data collection resulted in a revision to the form to refine types of note taking, research (i.e., electronic versus text), and a clarification of the operational definitions for each category of engagement. A Pearson product-moment correlation was run to determine interrater reliability. There was a positive correlation between raters during the simultaneous data collection, which was statistically significant ($r = .97$, $p < .001$).

Each student was assigned a code by the observer incorporating their group number (i.e., 1.1, 1.2) to maintain their consistency in recording, monitor absences, and keep the investigator blind to the identity of the students during the narrative content analysis phase of the study.

Student reflection journal assignments were completed at the end of each PBL module and assessed separately from the grading rubric used during the course. After the PBL modules, written journal reflections were de-identified by a research assistant and categorized by PBL group to minimize bias during the assignment of codes and categories. The investigator also maintained a set of field notes consisting of observations and reflections from participating as a facilitator during the PBL modules.

Data Analysis

The data analysis was completed in two stages. The quantitative analysis methods used descriptive and inferential statistics to examine data collected from observation of engagement behaviors using the study's observational rubric (See Appendix B). Quantitative analysis was also completed for the assessment data from the two previous non-PBL implementations of the course. The qualitative analysis occurred after the course ended, including thematic analysis of the written narrative reflection journals from each of the PBL problems, a final course reflection paper, and investigator field notes.

Quantitative Data. Data from the observational rubric was entered in an online statistical analysis software program data set (i.e., SPSS 24). Data was initially screened for accuracy by research assistants crosschecking tabulated frequency counts and then by the investigator. Assumptions of normality were screened using skewness and kurtosis. Descriptive statistics (e.g., frequency, mean) and ANOVA were used to compare the levels of different engagement behaviors for overall engagement, followed by verbal and nonverbal subcategories. Within each of the verbal and nonverbal subcategories, descriptive statistics were also used for each of the individual engagement behavior categories (e.g., questioning, researching).

In order to identify the presence of significant differences for engagement levels for the students between each level of the independent variable of subject presentation type, a within subjects ANOVA statistical test was used. A between subjects' ANOVA statistic was used for comparison of assessment data between prior two non-PBL years of SLHS 421 and the current PBL implementation since different groups were being compared.

Qualitative Data. In qualitative research, the voices of the participants are valued and provide a perspective from the participant on how they see and describe experiences (Creswell, 2016; Creswell & Poth, 2018). The qualitative analysis focused on reducing the volume of narrative data through the creation of descriptive and analytical notes. The combination of four different reflective journal assignments from each PBL module followed by a final course reflection assignment and investigator field notes was intended to provide an additional element of trustworthiness and validity by providing data for comparison from multiple sources. Using the actual words of the participant (i.e., in vivo) from the narrative text was also another strategy during the qualitative data analysis process to establish credibility (Straus & Corbin, 1990). The narrative journal assignments from each PBL problem were initially read in entirety by the investigator to identify statements of interest before the assignment of specific categories and codes. This step consisted of assigning a descriptive comment and/or analytical note to the narrative data. A second reading of the narrative journal reflections was completed by the investigator using elements from the study's conceptual framework (i.e., affect, authenticity, social interaction) as an initial guide for the coding of the raw qualitative data. Initial codes were assigned to specific statements from students and then recoded into more specific categories within codes from the conceptual framework. In addition, novel categories and codes were created as they emerged from the data. Categories and codes were organized using a Microsoft

Excel spreadsheet to link specific students and provide a visual organization of the code assignments and obtain frequency counts of codes. Narrative data from each PBL problem was analyzed separately in this manner to help identify the emergence of categories and codes related to specific PBL problems occurring during the study.

A final analysis step was applied to the final course reflection essay and the investigator field notes. This step consisted of assigning a descriptive comment and/or analytical note to statements of interest and then comparing them to the previous category and code assignments. Broad theme categories of psychological connection, social interaction, authenticity, career relatedness, PBL structure, prior knowledge, and accountability emerged from the coding process. Descriptive themes were then developed by reviewing the frequency of codes within each category, identifying the overlap of categories and codes between PBL problems, and observing redundancy in the final reflection assignment and investigator field notes. A colleague reviewed the category/code assignments for final agreement of between the identified category and codes with the designated descriptive themes. Pseudonyms were then assigned to student codes for ease in reporting specific statements from the qualitative findings.

Reliability, Validity and Trustworthiness. In order to establish a level of confidence or trustworthiness in this mixed methods study, specific steps were employed to ensure credibility and minimize threats to the validity of overall findings. In the quantitative methods of this study, the following steps were used to improve reliability and validity. For initial data collection using observational rubrics, the observers were blind to the study research questions and purpose to minimize bias in recording observed engagement behaviors. Students were also blind to the specific research questions and the behaviors the observers were recording. Simultaneous data collection by two observers occurred during the pre-study practice phase and periodically during

the study to assess inter-rater reliability of observed behaviors. Data collection using observational rubrics was completed on a rotating schedule to provide a balance of different time periods to address potential variability in engagement due to time effects. Each observer also completed training on using observational rubric for establishing valid definitions of engagement behaviors.

In the qualitative methods of the study, trustworthiness was also addressed in specific steps. Lincoln and Guba (1985) describe trustworthiness in qualitative research as collection of measures that enhance credibility and confirmability of results. Techniques employed in this study for establishing validity included triangulation of data sources (i.e., repeated participant reflections over time, investigator field notes, and observer observations), persistent observation of engagement behaviors and research field notes over a prolonged period of engagement by researcher and observers (i.e., four consecutive PBL problems over eight weeks), peer debriefing (i.e., end of PBL module debriefing sessions with participants), colleague review of final theme organization, a return to literature for discussion of interpretations and researcher reflexivity (Miles & Huberman, 1994). Triangulation is also described as a process of acquiring evidence from several informants and as a way to "build evidence from different sources to establish themes" (Creswell, 2016, p. 191). Similarly, prolonged engagement in the field is a validation strategy to improve accuracy of observational findings as the experiences are based on several experiences rather than an isolated observation (Creswell, 2016; Creswell & Poth, 2018). The students were engaged in the PBL process for eight consecutive weeks during the data collection to increase the length of time with PBL. This was intended to improve validity of the final analysis when combining the quantitative and qualitative findings.

The written student reflections and field notes also provided a detailed and thick description (Geertz, 1973), providing insight on how each problem may or may not have triggered motivation as students were experiencing each level of the independent variable (i.e., subject presentation type) using their own words and the observations of the investigator. Multiple student perspectives (i.e., 46 students at 5 different points in time) in the form of reflective journal assignments provided a richer understanding of the data for establishing descriptive themes than a single post-study reflection or focus group would have afforded. The category/code assignments were also reviewed by a colleague for final agreement of between the identified category and codes with the final qualitative descriptive themes. Finally, the process of reflexivity was included providing an understanding of the perspectives and role of the researcher. Reflexivity is described by Creswell (2016) as a process of describing research personal experiences and prior backgrounds, which may impact interpretations of findings. The role of the researcher for this study and her reflexivity statement follows.

Reflexivity Statement. As a researcher I had dual roles in this study, including implementing the PBL instructional approach as the facilitator of PBL tutorial groups and serving as the course instructor. These roles required me to design the structure of the course and implement the principles of PBL in my teaching methods. It also required me to incorporate prior teaching and clinical experiences to identify problem elements that would be motivating or support personal connections with the problem subjects during the design phase of the PBL problems. Speech and Voice Science is a course this researcher found personally challenging as a student, not only in mastering content knowledge, but also difficulty in making a successful transition to application, synthesis, and evaluative levels of learning. As a result, this provided motivation to effectively implement PBL in the study's setting to foster those connections. It

shaped her decisions to scaffold the problems using increasing levels of complexity and provide overlap in the domain knowledge. My experience as the previous instructor of the Speech and Voice Science course also impacted my role as a researcher, as it provided me with knowledge on the content areas that were challenging for students.

My previous undergraduate teaching experiences did not include PBL, yet provided a contrasting perspective in my role as course instructor requiring me to facilitate rather than dictate content. My proficiency as a PBL facilitator has the potential to impact the student experiences described in this study. My prior undergraduate learning experiences as a student exemplified many behaviors that are not desired in a learning environment, including surface learning, the inability to apply knowledge, and passive engagement. These experiences increased my awareness of how it may be difficult for students to shift behaviors from ones they have familiarity with in prior learning experiences and therefore, I was conscious of the need to provide ongoing explanations of the rationale for using PBL and provide encouragement for their efforts and their willingness to embrace change. Although PBL was not an instructional method used in my personal experience for SLP graduate courses, it was used successfully in my doctoral coursework. It was through this process I recognized and developed personal insight of the PBL process that mirrored clinical problem-solving strategies used in my previous clinical practice as a speech language pathologist (e.g., identifying what is already known, asking questions, researching content, and collaboration with colleagues). These are perspectives I attempted to share in my role as a PBL facilitator and course instructor to the students in this study by helping them to understand my personal experiences with learning and using PBL. It was important to me as an instructor to help students gain a perspective of how the foundational

knowledge of speech and voice science is applicable to their future roles in clinical settings, rather than only for students seeking a research career.

My clinical experiences as a Speech Language Pathologist also provided a perspective of the potential impact of a face-to-face interaction with a client. Knowing clients on a personal level has sparked my motivation when providing therapy. This experience aligned with theories informing the study's design and helped shaped the levels of the study's independent variable subject presentation type, which included a direct face-to-face interaction with one of the PBL problem subjects. A potential outcome of this study for the reader may be an increased awareness or reflection on how interaction with a real person during an instructional experience adds value to the experience. The participants of this study may also develop an understanding of how they developed and matured in their problem-solving abilities and their awareness of their gains in content knowledge in PBL learning environment. Participants may also develop a sense of confidence or accomplishment from listening to other accounts of content difficulty from peers and realizing there may be patterns of similarities in their learning experience with others from their class.

CHAPTER IV

RESULTS

The primary focus of this study compared how variations in the presentation type of the subjects used within PBL problem scenarios impacted student motivation as measured by the frequency of observable engagement behaviors (i.e., a combination of verbal and nonverbal) as students were participating in four consecutive PBL problems. The 2nd generation 3C3R problem design model (Hung, in press) provided the conceptual framework for developing the problem scenarios, which represented each of the four subject presence levels of the independent variable, subject presentation type: Level 1: fictional subject character presented using a written text description (PBL Problem 1), Level 2: a real subject presented using a written text description (PBL Problem 2), Level 3: a real subject presented using audio-visual elements (PBL Problem 3), and Level 4: a real subject presented in a face-to-face classroom interaction (PBL Problem 4). This framework guided the investigator with embedding affective elements of the conceptual framework within the PBL problems: psychological connections, authenticity, and social interaction. These elements were intended to provide a supportive context for fostering student motivation throughout a PBL experience, ideally maximizing the educational benefits of the PBL instructional approach.

Within this context, the study first examined how the presentation of the problem scenario (i.e., subject presentation type) impacted student engagement during PBL through direct classroom observations using an observational rubric. In addressing the first research questions—how does the subject presentation type affect student motivation as measured by

levels of engagement—the following hypotheses were considered in the quantitative data: (1) Student motivation measured by engagement level will be the highest when working on a problem presented by a real subject who is involved with the problem and present in a face-to-face interaction (i.e., subject presence Level 4), and (2) there are significantly different levels of observable engagement behaviors for the different subject presentation types.

Comparison of data between PBL problems is reliant upon the existence of similar conditions and opportunities for engagement by students across each of the successive PBL problems. Consistent attendance and equivalent PBL group sizes is one factor to consider when comparing differences in levels of observed engagement behaviors. Student participation was stable throughout each of the four PBL problems, as measured by the number of absences within each PBL problem module overall. There was one day in each of the first three PBL problems where one group had two students absent at the same time, otherwise all groups had no more than one absence per day and only 4 of 46 students missed more than one day overall during the study, providing a stable group size for engagement throughout the study. Absences were distributed across groups and the total number of absences was comparable in each of the four PBL problem modules. There were seven absences overall in PBL Problem 1 (96% participation rate), six absences in PBL Problem 2 (95% participation rate), seven absences in PBL Problem 3 (96% participation rate), and six absences in PBL Problem 4 (95% participation rate). Since there was only a one absence overall (1%) difference in participation rates among the four PBL problems, it may be safe to assume the attendance rate was consistent throughout the four problems. The numbers of students attending in the four PBL problems are therefore assumed to be equivalent and the engagement behaviors occurred in the four problems are safe to be

compared. A graph summarizing attendance for each day of data collection for each problem is provided in Figure 5.

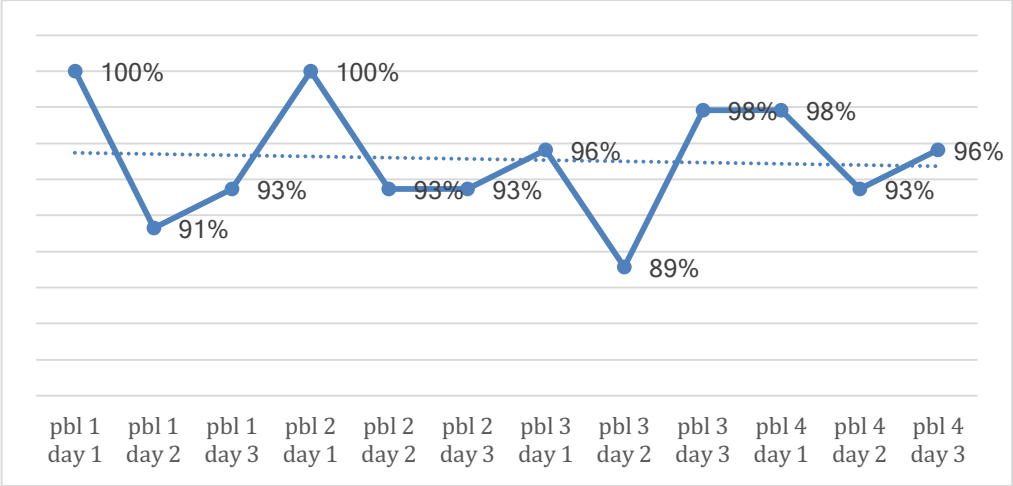

Figure 5. Percentage of Students Participating on each Day of Data Collection.

Quantitative Findings and Analysis

Engagement Behaviors

To begin addressing the hypothesis that there are different levels of observable engagement behaviors across subject presentation type and provide a context for later analysis of individual engagement behaviors, it is helpful to have an initial overall depiction of the frequency of engagement behaviors that occurred overall, and within the subcategories of verbal and nonverbal engagement. The frequency count of the total number of observable engagement behaviors, combining all verbal and non-verbal engagement behaviors, peaked with the PBL Problem 2 (i.e., Level 2: real subject, text), and then declined overall for both PBL Problem 3 and Problem 4. The overall number of total observed frequency behaviors was the lowest for PBL Problem 3 (i.e., Level 3: real subject, audio-visual). The overall trend in frequency of total engagement behaviors between the first PBL module (i.e., Level 1: fictional, text) and the last

PBL module (i.e., Level 4: real subject, face-to-face) was downward, as shown by the trend lines in Figure 6.

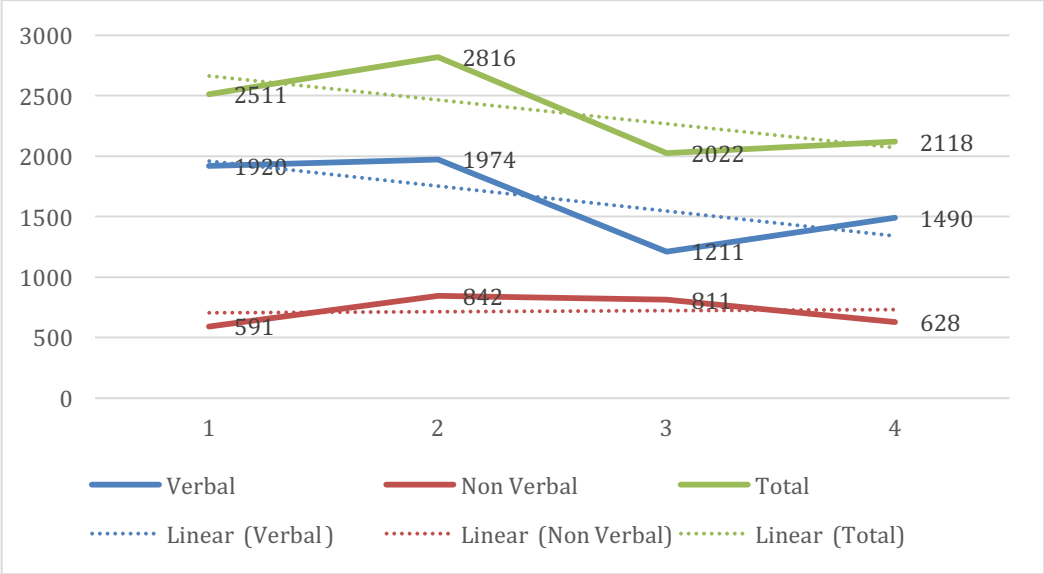

Figure 6. Total Frequency Counts of Engagement Behaviors across PBL Problems. *Note*: Verbal category excludes off-topic comments.

Although there was a downward trend in the total frequency of engagement behaviors overall (i.e., verbal and nonverbal combined) and also within the subset of verbal engagement behaviors, a first impression may be that the increase in the frequency of verbal behaviors (21%) between the third and the fourth PBL problems is indicative of a possible stabilization of the declining trend in overall engagement. It may support the argument that the Subject Presence Level 4 of the subject presentation type variable, a real subject in a face-to-face interaction, impacted students' motivation for engagement in a positive manner. Additional analysis of the mean differences between PBL problems for the total engagement and the subsets of engagement behaviors (i.e., verbal and nonverbal) for students will be discussed in Chapter V to parse the significance of this trend.

This initial, superficial review of descriptive frequency engagement data does lend some support for hypothesis that there are different levels of engagement for each level of the subject

presentation type variable; however, it does not substantiate the significance of mean differences between each level of subject presentation for the students. Since the total engagement data included two different categories of observable behaviors (i.e., verbal and nonverbal) that may have different implications for interpretation additional data analysis. A one-way (within subjects) analysis of variance (ANOVA) was applied to the verbal and nonverbal engagement subcategory variables separately in addition to the total engagement variable. This additional breakdown provided a more specific analysis of the mean differences between subject presentation type for the students within these two dichotomies of engagement.

Total Engagement (Verbal and Nonverbal)

The total engagement variable combined all observed engagement behaviors (i.e., verbal and nonverbal). A one-way (within subjects) ANOVA was conducted to evaluate the following hypothesis; there are significantly different mean levels of total observable engagement behaviors among each level of the subject presentation type variable. The results of this within subjects ANOVA for the total engagement variable indicated a significant effect—Wilks' Lambda = .553, $F(3,43) = 11.60$, $p < .001$, $\eta^2 = .45$. Post hoc comparisons using the Tukey statistic identified a significant difference (decrease) between PBL Problem 2 and PBL Problem 3 ($p < .001$) and also between PBL Problem 2 and PBL Problem 4 ($p = .004$) (See also Appendix E). Descriptive statistics for the total engagement variable are presented in Table 3.

Table 3. *Total Engagement Behavior Means across PBL problems*

PBL Problem 1 Fictional/text $n = 46$		PBL Problem 2 Real/text $n = 46$		PBL Problem 3 Real/video $n = 46$		PBL Problem 4 Real/face-to-face $n = 46$	
M	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
54.6	(22.7)	61.2	(25.6)	44.0	(15.1)	46.0	(20.4)

Note: Excludes individual verbal behavior of commenting: off topic

The mean differences for total engagement among students decreased between PBL Problem 1 and PBL Problem 4. This finding could possibly be related to students tiring or reducing their efforts with repeated PBL experiences. PBL Problem 4 (Level 4: real subject, face-to-face interaction) did not have the highest engagement mean of the four levels of subject presentation type overall as hypothesized.

Verbal Engagement. The total verbal engagement behavior variable included a compilation of all data from the following subcategories: questioning, confirming, general on-topic commenting, commenting specifically on personal interest or prior experience, reading aloud to share information, and suggesting an action or directive. Off-topic comments were excluded from the total verbal engagement variable analysis. The overall trend in total verbal behaviors was downward as shown in Figure 7, peaking in PBL Problem 2 (i.e., Level 2: real subject, text) and then declining in PBL Problem 3 (i.e., Level 3: real subject, audio-visual) before increasing with PBL Problem 4 (i.e., Level 4: real subject, face-to-face).

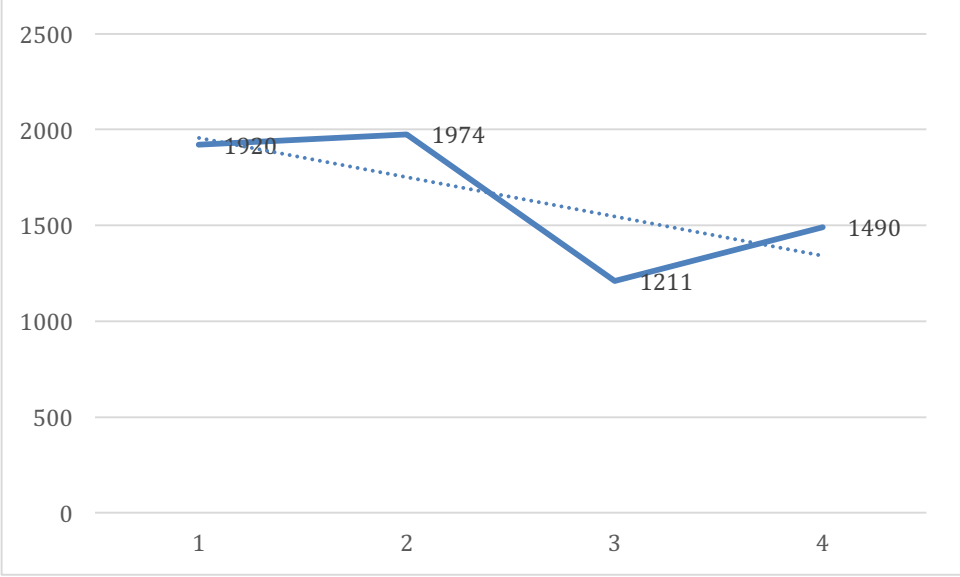

Figure 7. Total Frequency Counts of Verbal Subcategory across PBL Problems. *Note*: Includes individual verbal behavior categories: Questioning, Confirming, Comment On topic, Comment Prior Knowledge or Experience, Suggesting, or Reading.

A one-way (within subjects) repeated measure analysis of variance was conducted to evaluate the following hypothesis as it pertains to the subcategory of verbal engagement; there are different mean levels of observable verbal engagement behaviors among each subject presence level of the subject presentation type variable. The results of this within subjects ANOVA for the total verbal engagement variable indicated a significant effect—Wilks' Lambda = .42, $F(2.54,114.4) = 20.07$, $p < .001$, $\eta^2 = .24$. Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated; therefore, a Greenhouse-Geisser correction was used. Post hoc comparisons using the Tukey statistic identified a significant difference (decrease) between PBL Problem 1 and PBL Problem 3 ($p <= .001$) and also between PBL Problem 2 and PBL Problem 3 ($p < .001$) (See also Appendix E). Descriptive statistics for the verbal engagement variable and individual verbal behaviors are presented in Table 4.

Table 4. *Verbal Engagement Behavior Means by PBL Problem*

	PBL Problem 1 Fictional/Text $n = 46$	PBL Problem 2 Real/Text $n = 46$	PBL Problem 3 Real/Video $n = 46$	PBL Problem 4 Real/face-to-face $n = 46$
Verbal Engagement Total	*M (SD)* 41.7 (20.6)	*M (SD)* 42.9 (23.0)	*M (SD)* 26.3 (14.1)	*M (SD)* 32.4 (19.6)
Individual Verbal Behaviors				
Commenting – On topic	16.4 (9.0)	17.3 (11.3)	12.5 (6.8)	19.2 (11.2)
Confirming	9.5 (5.4)	9.8 (6.3)	5.0 (4.3)	3.7 (5.1)
Questioning	7.6 (5.2)	8.0 (5.5)	4.0 (3.4)	5.3 (3.5)
Commenting – Off topic*	7.2 (10.1)	8.0 (8.2)	4.2 (5.3)	5.6 (8.1)
Commenting: Prior Knowledge or experiences	.9 (1.7)	.5 (.9)	.3 (.8) .1	.1 (.4)
Suggesting Action or Directive	5.0 (4.0)	6.1 (4.7)	3.5 (3.4)	3.1 (3.5)
Reading to Share Knowledge	2.4 (3.1)	1.1 (1.1)	1.0 (1.4)	1.0 (1.0)

Note: *Total verbal variable excludes commenting: off topic

PBL Problem 2 had the highest mean of total verbal behaviors as found with total engagement overall. The same pattern of declining verbal engagement means across problems was then found, similar to the total engagement findings, with the exception of a modest increase between the PBL Problem 3 (M = 26.3, SD = 14.3) and the PBL level hypothesized to have the highest level of engagement, PBL Problem 4 (M = 32.4, SD = 19.6). PBL Problem 4 (i.e., Level 4: real subject, face-to-face) did not have the highest verbal engagement mean of the four levels of subject presentation type overall. However, the increase following PBL Problem 3 may provide some support of an impact occurring from PBL Problem 4 (i.e., Level 4: real subject, face-to-face) related to the verbal engagement subcategory.

Individual verbal engagement behaviors. The most frequently observed subcategories of verbal engagement were: commenting-on topic, confirming, questioning, and commenting - off-topic. A finding of interest was with on-topic commenting, which was the highest in PBL Problem 4 (i.e., Level 4: real subject, face-to-face interaction) despite it being the problem with lower levels of verbal engagement. A summary of frequencies for all subcategories is provided in Table 5 and displayed visually Figure 8.

Table 5. *Frequency Counts for Individual Verbal Engagement Behaviors by PBL problem*

Individual Verbal Engagement Subcategories	PBL Problem 1	PBL Problem 2	PBL Problem 3	PBL Problem 4	Total
Comment: On Topic	756	794	576	882	3008
Confirming	438	451	229	168	1286
Questioning	348	370	185	243	1146
Comment: Off Topic*	330	366	191	257	1144
Suggesting Action or Directive	230	283	163	145	821
Reading Aloud to Share Knowledge	108	53	44	48	253
Prior Knowledge or Experience	40	23	14	4	81

Note: *Off-topic comments excluded from Verbal Engagement Analysis

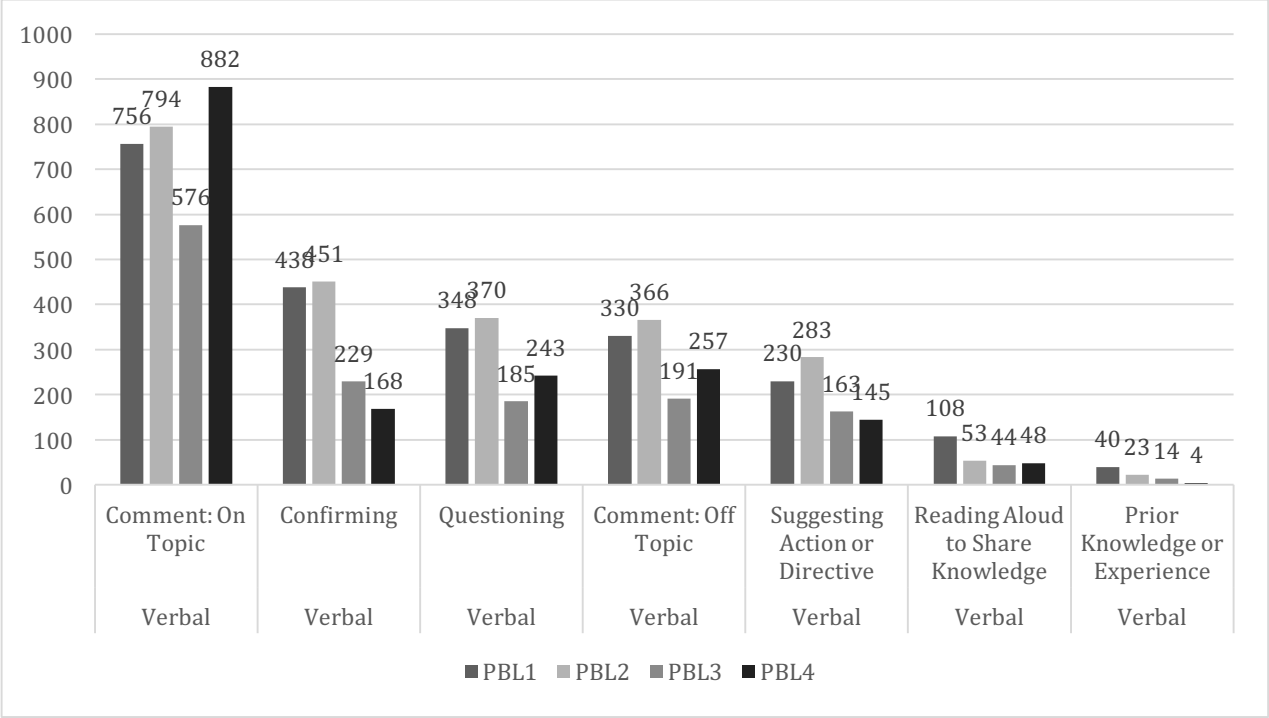

Figure 8. Comparison of Individual Verbal Engagement Behaviors.

Non-verbal Engagement. The total nonverbal engagement behavior variable complied data from the following individual nonverbal subcategories: listening with eye contact, contemplating, researching via written text researching via electronic media or text resources, organizing action (i.e., using white board or shared graphic organizer), and note taking (handwritten and typed). Figure 9 shows a stable trend in overall frequency for non-verbal engagement behaviors across levels of the independent variable, subject presentation type. Similar to the pattern observed in the total verbal behaviors and total engagement overall, the frequency of non-verbal engagement acts peaked with PBL Problem 2 (i.e., Level 2: real subject, text), however, there was a progressive decline with each subsequent PBL module after PBL Problem 2. Nonverbal engagement did not increase with PBL Problem 4 (i.e., Level 4, real subject, face-to-face) as was observed in the verbal engagement subcategory. It is of interest that the total frequency of observed non-verbal engagement behaviors was slightly higher in the last

PBL module than in the first PBL module creating a stable pattern in nonverbal engagement behaviors overall.

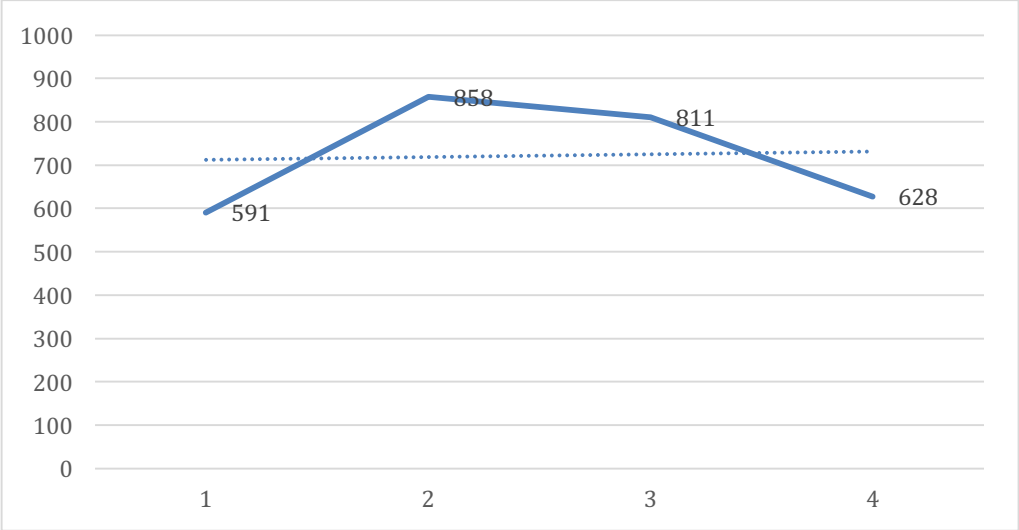

Figure 9. Total Frequency Counts of the Nonverbal Subcategory across PBL Problems. *Note*: Includes Listening, Contemplating, Researching, Organizing, and Note Taking.

A one-way repeated measure within-subjects ANOVA was conducted to test the hypothesis that there are different mean levels of total nonverbal engagement behaviors among each level of subject presentation type. The results of this within subjects ANOVA for the total nonverbal engagement variable indicated a significant effect— Wilks' Lambda = .49, $F(2.4,106.5) = 14.48$, $p < .001$, $\eta^{2} = .22$. Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, and therefore, a Greenhouse-Geisser correction was used. Post hoc comparisons using the Tukey statistic identified a significant difference (increase) between PBL Problem pairs 1-2 ($p < .001$) and also between PBL Problem pairs 1-3 ($p < .001$). There was a significant difference (decrease) between means for PBL Problem pairs of Levels 2-4 ($p = .001$) and 3-4 ($p = .005$). Descriptive statistics for the nonverbal engagement variable and the individual no verbal engagement behaviors are presented in Table 6 (See also Appendix E).

Table 6. *Nonverbal Engagement Behavior Variable Frequency Means by PBL Problem*

Nonverbal Engagement	PBL Problem 1 Fictional/Text *n* = 46	PBL Problem 2 Real/Text *n* = 46	PBL Problem 3 Real/Video *n* = 46	PBL Problem 4 Real/face-to-face *n* = 46
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*
	12.9 (7.1)	18.3 (6.3)	17.6 (4.4)	13.7 (4.1)
Individual Nonverbal Behaviors				
Listen with Eye Contact	4.9 (3.1)	6.2 (2.8)	5.6 (3.0)	3.6 (2.1)
Research Electronic Media Resources	1.7 (1.8)	3.3 (2.3)	3.5 (2.1)	4.3 (2.1)
Research via Text Resources	2.2 (1.7)	3.0 (1.9)	3.7 (2.2)	1.0 (1.1)
Notetaking by Typing	.4 (.8)	1.5 (2.1)	.7 (1.0)	.4 (.8)
Contemplating	.7 (1.0)	.54 (.9)	.2 (.5)	.3 (.5)
Notetaking by Hand	.8 (1.3)	1.3 (1.7)	1.1 (1.8)	1.2 (1.8)
Organizing- white board or graphic organizer	2.1 (2.3)	2.5 (3.0)	2.9 (2.1)	2.9 (1.7)

Although the mean level of nonverbal engagement behaviors for PBL Problem 4 (i.e., Level 4: real subject, face to face interaction) did not increase as it did for verbal behaviors, the overall mean level of nonverbal engagement was not significantly different between PBL Problem 1 and PBL Problem 4 level of subject presentation type. It is possible the nonverbal category was a less sensitive measure of engagement given shifts in nonverbal behaviors may be less visible or overt than verbal engagement behaviors, and therefore, possibly under reported.

Individual nonverbal engagement behaviors. The most frequently observed subcategories of individual nonverbal engagement behaviors were: listening with eye contact, researching using electronic media or text resources, and organizing actions. A gradual increasing trend in frequency was observed for researching using electronic media and also for

organizing actions. A summary of the frequencies for the individual nonverbal engagement behaviors is displayed in Table 7 and Figure 10.

Table 7. *Frequency Counts for Individual Nonverbal Engagement Behaviors by PBL Problem*

	PBL Problem 1	PBL Problem 2	PBL Problem 3	PBL Problem 4	Total
Listening -Eye Contact	227	295	256	165	943
Research -Electronic Media	78	153	160	197	588
Organizing action	96	113	131	134	474
Research Text	101	138	172	47	458
Take Notes by Hand	37	58	52	56	203
Taking Notes by Typing	20	68	31	17	136
Contemplating	32	25	9	12	78

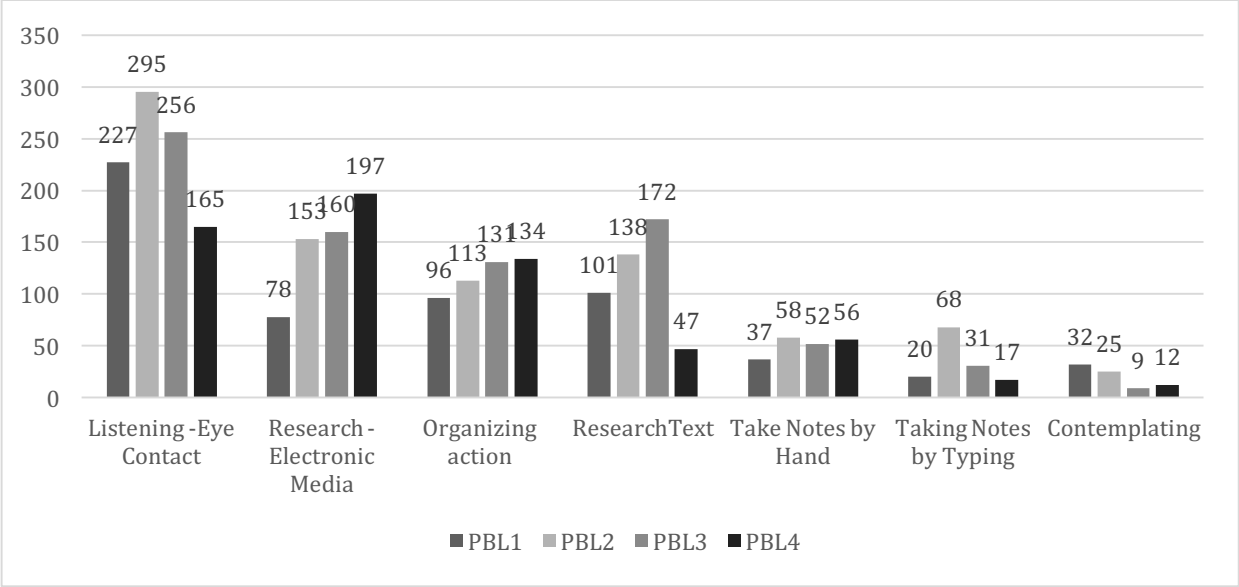

Figure 10. Comparison of Individual Nonverbal Engagement Behaviors.

One individual nonverbal engagement behavior emerged with an interesting pattern. Despite the overall trend of declining or stable frequency of nonverbal, researching using electronic media increased progressively throughout the study (See Figure 11).

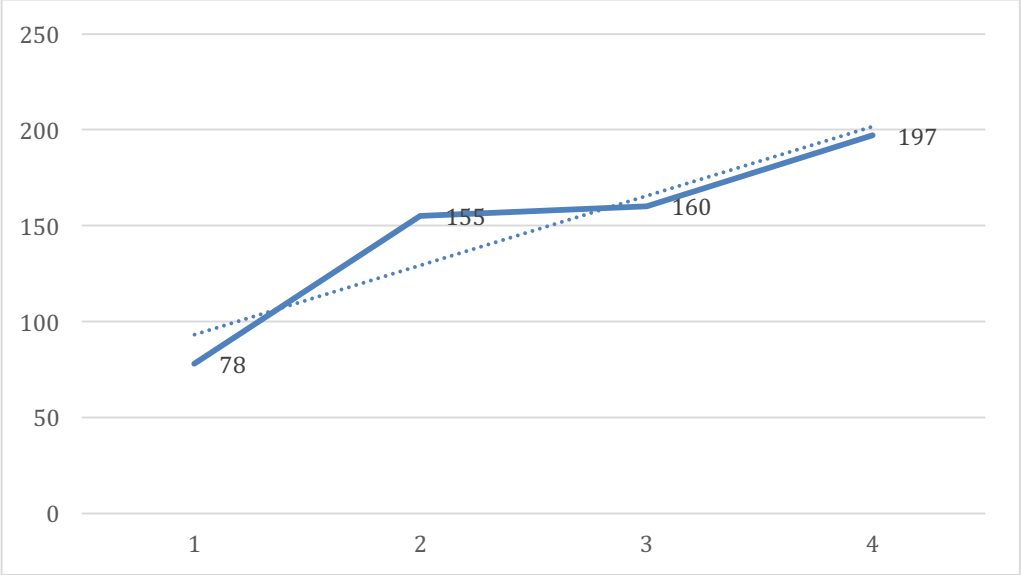

Figure 11. Total Frequency Counts of the Individual Nonverbal Behavior: Researching using Electronic Media across PBL Problems.

It is possible students were developing improved problem-solving strategies and research habits as they gained experience with the PBL process, or the different levels of subject presentation types or the problem content topics may have sparked motivation to engage in nonverbal research behaviors more frequently. It also may provide support for the idea that that it is possible to increase motivation for individual nonverbal engagement behaviors, even in the presence of overall stable or declining frequency of other individual engagement behaviors. The increasing frequency of research may have been affected by emerging content knowledge or from a lack of prior knowledge. The final PBL problem may also have prompted more research because of the nature of its problem statement, advising students to use evidence in their recommendations for instrumentation options.

Content Assessment

The final aspect of this study compared assessment data from the current Speech and Voice Science (i.e., PBL implementation) with previous, non-PBL Speech and Voice Science course implementations. This addressed the following research question: Does PBL provide an

effective instructional method for content mastery for Speech Science learning outcomes within a Speech, Language and Hearing Sciences undergraduate course. It was hypothesized that PBL would be an effective instructional strategy for mastery of speech and voice curriculum.

Comparison of exam scores from prior years. A one-way between subjects ANOVA was conducted to compare the mean differences in exam scores for domain content knowledge from two prior Speech and Voice Science course implementations (i.e., non-PBL), which were matched with a final domain content (i.e., factual knowledge only) assessment from the study's PBL course implementation (i.e., 2017). The ANOVA was significant, $F(2,122) = 4.98$, $p = .082$, $\eta^2 = .076$. Follow-up comparison tests were conducted to evaluate differences among the means using the Scheffe statistic. A summary of the exam scores and mean differences between years is provided in Tables 8 and 9.

Table 8. *Comparison of Exam Scores for Final Exam*

			95% Confidence Interval	
Exam Year	*N*	*M* (*SD*)	Lower Bound	Upper Bound
2014 Exam	42	86.0 (13.5)	82.5	89.5
2015 Exam	37	84.4 (8.8)	80.7	88.1
2017 Exam	46	78.7 (10.9)	75.4	82.1

Note: 2016 was excluded as it was pilot of PBL and an alternative assessment was used

Table 9. *Multiple Comparisons following One Way (Between Subjects) ANOVA for Comparison of Exam Scores*

				95% Confidence Interval	
Exam Year Pairs	Mean Difference	*SE*	*p*	Lower Bound	Upper Bound
2014 – 2015	1.6	2.6	1.0	-4.6	7.8
2014 - 2017	7.27	2.4	.013*	1.26	13.3
2015 – 2017	5.6	2.5	.08	-.42	11.7

Note: The mean difference is significant at $p < .05$. Assumption for Levene's test of equality of error variances was met ($p > .05$). Omnibus measure: $F(2,122) = 4.98$, $p = .008$, $\eta^2 = .076$.

There was a significant difference (decrease) in the means between the 2014 (non-PBL) group and 2017 (PBL), but no significant difference between 2014 and 2015 (non-PBL), or 2015 and 2017 groups. The mean exam score of 78.7 from the PBL year was the lowest mean score (M = 78.7) when compared to the prior two non-PBL years (2014, M= 86.0, SD = 8.8; 2015, M = 84.4). Given the findings, the results are inconclusive. However, a mixed finding of one significant difference and one non-significant difference between the exam years may indicate other factors within each course implementation affected test scores.

Formative assessments in the form of online quizzes were also completed for the purpose of achieving content mastery of textbook content in PBL and non-PBL course implementations. A one-way between subjects ANOVA was also conducted to compare the mean differences in average quiz scores from prior Speech and Voice Science course implementations with the years using PBL pilot and PBL study implementation (i.e.,2016 and 2017). The ANOVA was significant, $F(3,152) = 52.4$, $p < .001$, $\eta^2 = .509$. Follow-up comparison tests were conducted to evaluate differences among the means using Scheffe statistic. A summary of exam scores and mean differences between years is presented in Tables 10 and 11.

Table 10. *Comparison of Mean Quiz Scores for Domain Knowledge of Textbook Content*

Year	*N*	*M (SD)*	*SE*	95% Confidence Interval Lower Bound	Upper Bound
2014	42	71.9 (5.0)	.9	70.2	73.6
2015	37	86.8 (6.3)	.9	85.0	88.6
2016*	31	83.7 (4.5)	1.0	81.7	85.7
2017**	46	80.4 (7.9)	.8	79.0	82.3

Note: * PBL Pilot year **PBL study year

Table 11. *Comparison of Mean Differences following One Way (Between Subjects) ANOVA for comparison of average Quiz Scores.*

Years				95% Confidence Interval	
	Mean Difference	*SE*	*p*	Lower Bound	Upper Bound
2014- 2015	14.9	1.3	<. 001*	11.5	18.3
2014 – 2016	11.8	1.3	<. 001*	15.3	8.2
2014 – 2017	8.7	1.2	<. 001*	11.9	5.5
2015 – 2016	-3.1	1.4	.13	-6.8	.5
2015 – 2017	-6.8	1.2	<. 001*	-2.9	-9.5
2016 – 2017	-3.0	1.3	.12	-.4	-6.5

Note: * The mean difference is significant at <.001. Assumption for Levene's test of equality of error variances was met ($p > .05$), Omnibus measure: $F(3,152) = 52.4$, $p <. 001$, $\eta^2 = .509$

There was a significant difference in the means (increase) between the 2014 (non-PBL) group and the two PBL years (2016 and 2017), but no significant difference between 2015 and 2016, or between 2016 and 2017 groups. The mean quiz average was the lowest in the first non-PBL year (71.9) and was also the highest in a non-PBL year (86.8). The average quiz scores for the PBL year fell within the middle range of the high and low quiz scores overall. Again, as with the exam scores, the results are inconclusive. The variation in content mastery for textbook domain knowledge may be impacted by factors (e.g., student differences) rather than specifically related to the implementation of PBL as a learning approach. Content mastery of textbook domain knowledge does appear to be occurring in both PBL and non-PBL course implementations.

Assessment scores from the current PBL course. To help understand whether PBL that would be an effective instructional strategy for mastery of speech and voice curriculum within the specific context of this study, assessment data from the current year was also

examined using descriptive statistics. Students completed three online content assessment quizzes (i.e., one for domain (factual) knowledge of each of the first three PBL modules), an applied project (i.e., oral presentation and written summary on a course concept or scholarly article to assess applied knowledge), and a final assessment exam of content (factual knowledge from PBL3 and PBL 4). A summary of exam scores is provided in Table 12.

Table 12. *Assessment Scores within 2017 PBL Course*

				95% Confidence Interval	
	N	*M (SD)*	*SE*	Lower Bound	Upper Bound
PBL1 Content Assessment Quiz	46	86.9 (9.8)	1.5	84.0	89.8
PBL 2 Content Assessment Quiz	46	92.9 (6.1)	.9	91.1	94.7
PBL 3 Content Assessment Quiz	46	88.4 (9.3)	1.4	85.6	91
PBL Applied Project	46	94.0 (3.8)	.6	92.9	95.1
Final Exam PBL 3 & 4 Domain Content	46	78.7 (10.9)	1.6	75.5	82.0

The mean score for the final exam covering PBL 3 and PBL 4 domain content (78.7) was the lowest mean score of the course assessments. This may suggest the mastery of content objectives for factual knowledge concepts was not fully demonstrated. However, the strong performance on the applied project ($M = 94.0$, $SD = 3.8$) does suggest students were able to demonstrate application of some content knowledge for speech and voice science in an alternative assessment that included an oral and written component. The final exam assessment may also possibly be lower because of students having to recall information in a context that was less applied than the format of their learning activities. The exam was administered without the ability to use outside resources or collaboration, which was allowed in the applied project.

Qualitative Findings and Analysis

In order to understand other factors that may have been occurring during each of the PBL problems, the qualitative analysis was accomplished using a thematic content analysis of student reflection journals and investigator field notes. Moustakas (1994) describes the process of recognizing statements of interest and significance, followed by more meaningful categories as part of the process of developing descriptive themes. Vaismoradi, Turunen, and Bondas (2013) summarized the process of thematic analysis for qualitative data from Braun & Clarke (2006) as a reading and rereading data, identifying key ideas, generating codes, and compiling codes into categories that support themes. Thematic analysis of student reflection journals and investigator field notes were used to provide further insight to the initial quantitative data from this mixed methods study. In addition, a final reflective journal assignment and investigator field notes were analyzed at the conclusion of the Speech and Voice Science course, providing a retrospective view of the students' experience. Analysis of the qualitative data resulted in the following major themes derived from the development of codes, categories, and descriptive subthemes (See Table 13). A complete summary is provided in Appendix D.

Table 13. *Summary of Major Qualitative Themes*

1. Personal relatedness transpired from subject and problem characteristics.
2. Student motivation and engagement varied with perceptions problem difficulty and prior knowledge.
3. Nature of engagement shifted from communitive to researching.
4. Direct interaction with problem subject and high solution value enhanced accountability and realism.
5. Group dynamics and PBL supports (i.e., assigned roles, learning artifacts) fostered a positive learning experience

The first major qualitative theme was applicable to this research question: **How does one's career interest, personal connection/interest, or prior experience with subject problem content area or other factors affect student motivation and engagement when participating in a course using PBL?**

Theme 1 Personal relatedness transpired from problem and subject characteristics. Aligning with the psychological connection aspect from conceptual framework (2nd generation 3C3R model) used in the problem design, students expressed with regularity their connection to the characteristics of the problem scenario and subject in their reflection journals. Personal relatedness was established from several perspectives related to the problem and/or subject characteristics, exemplified by following categories that supported the development of this theme: related or similar prior experiences (with clinical disorder, family/friends or self), personal interest and curiosity (in subject, in content or clinical disorder), empathy and emotion, applicability to career aspirations and required skillsets, and similarity with personal attributes.

Relatedness from prior experiences. Students indicated a psychological connection in their reflective statements with a high frequency of comments related to personal experience or interest (i.e., PBL Problem 1 (33%), PBL Problem 2 (35%). However, the frequency of comments related to personal experience and interest was also high in PBL Problem 3 (34%) (i.e., real subject, audio-visual), despite a significant drop in observed levels of verbal engagement that was identified in the quantitative data. Personal interest and related experience may have initially provided support for high levels of engagement. However, it may not have been sufficient or sustainable for maintaining a high level of observed verbal engagement behaviors in all subject presentation types (i.e., PBL Problem 3).

Prior experiences may have helped create personal relatedness when students identified similarities with their own experiences. A strong example of this connection is demonstrated in this student's description of the applicability to her prior experience:

> *This PBL (PBL Problem 1) really gave me some insight on how breathing can work for someone who has paresis or is paralyzed from the chest down. I currently work with a client who has cerebral palsy and I applied a lot of this info to what we do with her.* (Sara)

Nancy expressed her prior experience to the problem characteristics by stating: "*I was able to directly relate to this PBL module as my grandfather suffered a spinal cord injury just three weeks ago."* This was also echoed by Jenny's comment related to PBL Problem 2, "*I was motivated to discover possible interventions that could help the client increase her loudness. Although I don't personally know individuals who are quadriplegic, I enjoyed listening to my group members' experiences*". Examples of students describing how they were able to relate to the problem characteristics continued in PBL Problem 3.

> *I liked that (subject) was more relatable with this problem. Especially as college students, working to help a client with their speech to make them more understandable by students is something we totally understand. I have had classes with professors whose primary language was not English and there are definitely times that it makes it difficult to learn because you are concentrating so hard on understanding what they are saying. So I felt like it was a super relatable topic, even though it was a little more difficult.* (Sherry)

> *When we first started discussing this client in class I immediately was intrigued with his case. The reason for stating this is because when I went to school at (X) I had a professor*

*who was in this exact same position as (*PBL Problem 3 subject*). I had just started my class and from the second I heard this professor speak I knew immediately that both the professor and I were going to struggle with communication.* (Wendy)

Students were able to establish a personal connection or relatedness not only from their own experiences, but also from hearing other students discuss their prior experiences within the collaborative design of the PBL approach.

Relatedness from personal interests and curiosity. Some students were able to establish personal relatedness from more than their prior experiences; they were also successful in recognizing their personal interests and curiosity in specific problem characteristics and content. Qualitative codes of interest and curiosity were identified in the following statements supporting this theme.

The PBL (PBL Problem 1) did line up with my personal interests. I once saw the movie "The Sea Inside," and it was about a quadriplegia man living in Spain with his family. I saw the emotional, medical, and personal side of quadriplegia. Since viewing the movie, I've not only been interested in quadriplegia, but how it limits the client's breathing/daily living. (Faye)

Sandy provided a slightly different perspective highlighting both a connection between her personal experiences in PBL Problem 3 and her on personal curiosity with individuals who are learning a second language.

*This module was my most motivating and interesting to study and learn about. The newness and how it is used to treat accent reductions was very fascinating to me. Through all the (*my*) moves, foreign soccer coaches, and knowing another language*

myself, I am very drawn to the differences in language and the process of accumulating speech traits to your immediate environment.

In another example, Eileen noted the interest in specific content elements related to PBL 3 as motivating. *"I was motivated to learn about the formants and spectrograms…My interest in the topic was a major influence on my motivation for this module."* These statements highlight an overlap between prior experiences and personal interest in problem and subject characteristics, yet each appears to provide an avenue for creating personal relatedness, which may facilitate motivation. The identification of a prior experiences or personal interests also appeared to overlap with the development of empathy and emotion developed from problem and subject characteristics.

Relatedness from emotion and empathy. The frequency of statements related to empathy and emotion was the highest in PBL Problem 1 (24% of students), which was interesting given the subject presentation type was a fictional character, yet it aligns with quantitative data describing frequency of engagement behaviors being the second highest in PBL Problem 1. Student reflective statements included empathy directed toward how the clinical diagnosis of quadriplegia problem impacted the subject's quality of life, how it impacted her life as a college student (a relatable attribute of study participants), and a desire to help the client. Students also expressed emotion related to ancillary aspect of the problem scenario, demonstrating a personal interest in the potential for using a service dog, which was being evaluated as a part of the problem. Although the problem scenario on PBL Problem 1 did not specify a name for the fictional character, it was also interesting to observe that five of the eight PBL groups spontaneously assigned a name to the fictional character in their group reporting. One group described during their presentation of their recommendations, that they felt it made it easier to

talk about the problem in their group and it made it more personal. The frequency of empathy and emotion related comments among students decreased in PBL Problem 2 and PBL Problem 3. However, in the PBL Problem 4 (i.e., real subject, face-to-face interaction), the category of empathy emerged again with statements that were related to the students' desire to directly help the problem subject (i.e., clinic university director) and the graduate students working in the clinic through their research efforts and recommendations. Emotional connections and empathy facilitated a positive learning experience and supported the personal relatedness that was anticipated to spark motivation.

Relatedness to future career aspirations, work settings and skillsets. Each problem scenario was designed around a different SLP specialty area and future work settings (i.e., rehabilitation services, outpatient therapy, university clinic), which was connected to the Speech and Voice Science course content (i.e., Speech Breathing, Voice, Articulation, Acoustic Analysis) in the PBL design. Connections with career interest or novel and/or unique specialty areas emerged in the PBL Problem 1 and were present in each subsequent problem scenario. The frequency of reflective statements related to career relatedness category and codes peaked, however, with the PBL Problem 4 (30%), a problem that required students to make specific instrumentation recommendations for the university clinic. The following statement summarized how students viewed the applicability of the problem to their future careers.

> *The fact that I may one day use the applications and software that was recommended during class also helped me stay interested throughout the module, as I wanted to make sure that I would recommend something that I would both want to use and find helpful in a couple of years.* (Michelle)

It is possible the familiarity of the university clinic setting heightened students' recognition of the relatedness of the problem to future career aspirations, as many students anticipate working in a university clinic in the next couple of years.

Students also identified relevant skillsets for their future careers (i.e., multidisciplinary collaboration, need to communicate effectively) from the problem characteristics as being relevant to their ability to relate to the problem and supporting their motivation for engagement. Jen illustrated this connection to a required future skill in her statement from PBL Problem 2 *"I think the parts of this module where we had to put the information we found into conversations so that the patient and family could understand is a crucial skill to have."* It is possible that one benefit of students realizing the connection to their future skill or career aspirations is the creation of interest to engage and a reason to sustain effort. The similarity of the collaborative aspect of PBL with the multidisciplinary collaboration aspect of the problem characteristics and SLP skillsets was supported by Janet's reflection from PBL Problem 1.

> *Problem based learning in itself creates an environment that is similar to the situations that we as future SLPs will be partaking in, and the fact that I wasn't just expected to memorize different facts and statistics but was encouraged to explore a real-life case made the learning process a lot more enjoyable.* (Janet)

In this case, the problem characteristics (i.e., interdisciplinary) and the PBL instructional approach added value to the student's experience and also supported her personal relatedness to her future career environment.

Relatedness to similarities with problem subject. A final aspect of problem and subject characteristics for personal relatedness supporting this theme, stemmed from similarities with the problem subject attributes. Similarities appeared to provide a sense of realism to support

relatedness for some students. For example, several students referenced the similarity of age of the college student (i.e., subject characteristic) in PBL Problem 1 and PBL Problem 2 as helping trigger empathy and interest. The personal characteristics of the subject, while of interest to many students of similar age, also connected with Megan, a non-traditional student: "*It also made me think of when I was 20 years old, and how much communication meant to me at that age."* Some students also noted the similar and relatable career aspirations of the subject in PBL Problem 2 (i.e., student teacher) to their own aspirations to become Speech Language Pathologists. In PBL Problem 3, students were able to relate to the subject's profession and the problem setting as applicable to their immediate surroundings (i.e., professor, college), perhaps also contributing to a higher level of authenticity.

As noted throughout the descriptive statements and sub points supporting this theme, the problem and subject characteristics that were embedded in each PBL problem design provided a foundation for personal relatedness to transpire for students. It is possible the closer the alignment between subject and learner—whether from prior experiences, personal interests, emotion/empathy, applicability to career interests, or similarities with problem subject attributes—the more likely relatedness may emerge, supporting students' motivation to sustain effort and interest during PBL. The next theme is not specific to aspects related to career interest, personal connection/interest, or prior experience from this research question, however, it does address other factors that may affect student motivation and engagement.

Theme 2 Student motivation and engagement varied with perceptions of problem difficulty and prior knowledge. The subject presentation type (i.e., fictional versus real) was not a prominent aspect addressed in student reflections following the initial three PBL problems, rather descriptive statements pertaining to content were more prevalent. Students expressed

varied levels of prior content knowledge and differing perceptions of content/problem difficulty as impactful. These variations resulted in creating feelings of stress for some (potentially a negative influence on engagement), while the challenge and novelty of problem content was described as motivating by others (potentially a positive influence on engagement). In the first two PBL problems (i.e., fictional-text and real subject-text), when the frequency of verbal engagement behaviors was highest, narrative comments noted the overlap of content areas from prior courses (e.g. anatomy and physiology) were expressed as being positive aspects of their learning experience, when uncertainty about the PBL process was still high. The uncertainty with PBL began to diminish after the 1st PBL problem. Signs of increasing comfort with PBL and the role of prior content knowledge were expressed by this student.

> *"When our group started discussing this case (PBL Problem 2) we were pleasantly surprised at how much it was easier this time around! We figured it was likely due to us getting familiar with how to divide duties and tackle tough issues, but also because we had background with vocal nodules during the beginning of this course."* (Katie)

Perceptions of content difficulty shifted significantly with PBL Problem 3, emerging as frequent category of comments. Most students described PBL Problem 3 as challenging because of the novel and difficult content it contained, yet many also found it motivating because of the challenge it provided. Eileen's reflection provides an example of this perception.

> *The most motivating and challenging problem based learning module was definitely the one focused on accent modification. The terminology in this module was very unfamiliar to me and my entire group and because of this we had to work harder than before to understand the information.*

Eileen's description highlights a low level of prior knowledge, yet she states her effort increased as a result. Another student, Abby, expressed a similar sentiment specifically related to PBL Problem 3 saying: *"Out of all the modules, this is the one that I knew the least about coming into the course. This was extremely motivating for me because I wanted to learn answers."* Also in PBL Problem 3, the reflective student statements began to illustrate variations in responses to the stress created by low levels of content knowledge and problem difficulty and how it affected engagement. Paige described the impact on her engagement as follows: "*I wanted to ask my group (more questions) but I guess I didn't want to ask knowing the stress we were all under."* Emma described the challenge and stress with learning content associated with the problem this way: "*This PBL problem scenario was all brand-new information for me. I was fairly overwhelmed at the beginning and my group members were feeling the same way."* There was evidence that the problem scenario complexity also impacted the experience, as also noted by Kris: "*Module three was difficult because I had little background knowledge of clients receiving services to improve their English. It was difficult to understand that most of the English consonants we use are not present in Mandarin Chinese*." The differences between the phonological systems of English and Mandarin were not domain content specific to Speech and Voice science learning outcomes, rather related background knowledge necessary for applying knowledge to the problem. The added problem complexity identified by students was not anticipated to be a barrier during the problem development, yet it emerged as noteworthy aspect for the students.

The low content knowledge sparked engagement for other students. For example, Sophie stated "It *had also been the first PBL (PBL Problem 3) that we had no previous knowledge of (*domain content*). Not having any knowledge of this subject made us more reliant on the*

discussions between group members. When one group member seemed to struggle with one concept another would step in and help teach that aspect of information. I do believe this was our best interaction between our group members because of these characteristics".

Observations from the instructor aligned with the variation of student responses to low content knowledge and problem difficulty, with some groups asking more specific questions during tutor time and displaying enthusiasm for the topic, and other groups displaying visual frustration with the difficulty of the content concepts.

The combination of personal interest (i.e., identified in Theme 1) and lower problem difficulty in PBL Problems 1 and 2 may have supported high levels of engagement regardless of the subject presentation type (i.e., fictional or real). The perceived difficulty of content knowledge described by students for PBL Problems 3 and 4 may help explain the significant decline in the frequency of verbal engagement behaviors observed in the quantitative findings. The transition to a more difficult and less familiar content knowledge occurring in the third PBL problem scenario may have overshadowed the anticipated effect of the enhanced social presence of audio and visual elements of the Subject Presence Level 3 in the presentation of the problem scenario presentation.

In PBL Problem 4 (i.e., real subject, face-to-face), the PBL problem difficulty was similar to the previous problem and students were able to access their prior knowledge from the previous problem modules, as the order of problems in the course design was intended to include overlapping domain knowledge areas. However, low prior knowledge on the instrumentation options and the open-ended nature of potential solutions for solving the PBL problem 4 likely contributed to perceptions of problem complexity. The impact of this was expressed by Valerie, who said: "*Module number four was a challenge, but also a great learning opportunity. There*

are so many apps and programs available; it made it hard to decide where to start and how to compare." Not knowing where to start may help explain the decline in verbal engagement, since a discussion on prior knowledge would have been limited if most students had limited knowledge to share. The lack of prior knowledge on the key aspect necessary for develop a problem solution recommendation for PBL Problem 4 (i.e., instrumentation) may help explain a change in the nature of engagement in the next theme.

Theme 3 Nature of engagement shifted from communitive to researching. As students engaged with PBL Problem 3, there were some signs of a shifting the nature of the engagement behaviors. In the quantitative data, a gradual increase in the non-verbal category of researching with electronic media was observed with each subsequent PBL problem and statements applicable to this behavior began appearing in PBL Problem 3 and were observed by the classroom observers and instructor. The frequencies of exchanges of verbal engagement to be offset by an increase in nonverbal researching activities. For example, Eileen noted, "*We focused on much more research in this module (PBL Problem 3) than before and we did research throughout the whole module instead of just during the first few days or so."* The necessity to gain knowledge on less familiar domain topics appeared to facilitate collaborative researching of less familiar content for PBL Problem 3. Eileen continued to discuss how her group was using a collaborative approach with peers while also engaging in research behaviors.

> *Our group discussions were also quite detailed compared to the other modules. We went more into depth with this topic than we did in previous modules. We interacted more with the instructor during this module to solidify what we were learning and to get assistance when we were having trouble understanding a topic. Our group was of course motivated*

to get a good grade. We had done well on the modules so far and didn't want to do a bad job on this one.

This reflection describes engagement at a high level, yet the engagement in research activities may have offset verbal engagement behaviors or shifted toward engagement with facilitator to provide reassurance for lower levels of content knowledge. The trend for research behaviors continued in PBL Problem 4. Jane described how their group was focusing on research activities: *"We divided ourselves into researching existing apps (apps that the clinic currently has), potential apps (future purchase possibilities), potential software, and alternative resources (EPG, EGG, ultrasound*)." Investigator field notes and classroom observers also described students as being predominately on task in their last PBL module, although often engaged in periods of silent research or contemplation and fewer group discussions. It may be plausible that the increase in the nonverbal engagement behavior of researching using electronic media impacted the overall frequency of verbal engagement behaviors by replacing discussion behaviors of commenting and questioning with non-verbal behaviors of reflection or researching. Non-verbal tasks of researching are likely to be longer in duration, therefore a lower frequency count may not capture the extent of engagement and leave less time for verbal engagement. As students became more proficient with online collaboration tools, it is also possible dialogue between students was shifting outside of the classroom.

Rather than engaging frequently in verbal discussions students were increasingly spending more time in quiet periods of research in observations from the instructor field notes during PBL Problem 4. One contributing factor may have been the decline in the strict adherence to steps of PBL and use of PBL roles. The classroom observers noted the way some groups used of PBL roles varied. PBL roles were inconsistently employed among groups,

starting as early as PBL Problem 2. The potential impact of this on engagement was expressed by April, who noted her concern: "*I noticed our group work and discussion was not as successful if we did not follow our given positions.*" One group, for example, decided there was redundancy occurring in their group and adapted their process, preferring to only use the timekeeper role to keep the discussion and research activities moving forward. This group preferred to have everyone act as the recorder since they were using a shared collaborative online document that everyone could access simultaneously and make comments on during the group meetings in a faster manner. Faith described her group's deviation from roles as follows: "*I've noticed in our group that the roles we pick in the module aren't usually carried through,*" providing a sign that the faithfulness to PBL steps was variable among groups. It is possible an interaction of low content knowledge and a loss of faithfulness or variability for the steps within PBL structure (i.e., declining fidelity) may have played a role in the changing nature of engagement from communitive to research-oriented, as reflected in this theme's description of a shifting nature of engagement.

The next theme has applicability to this research question: **How does the subject presentation type of problem scenario (e.g., a real person who is involved in the problem case) within a PBL problem scenario affect student motivation measured by levels of student engagement during the PBL instructional process.** In the final PBL problem, the frequency of researching with electronic media peaked (i.e., nonverbal engagement behavior); however, the qualitative data provided an insight into another possible factor regarding motivation, an enhanced level of accountability associated with the problem subject presentation type and a high level of urgency to discover a problem solution despite a lower frequency of observable engagement behaviors.

Theme 4 Direct interaction with problem subject and high solution value enhanced accountability and realism. Initially, accountability was referenced by students as being directed toward peers as an artifact of the PBL structure (i.e., peer teaching). This type of peer accountability was described by Joni:

> *The aspects of this problem (PBL Problem 1) that affected my motivation to engage me with my peers were that we would brainstorm questions that we needed to answer in order to answer the PBL. Then we each researched about our topic and reported back to our group at the next class period. This was motivating for me as I made sure I understood my topic and was able explain it to others and answer any questions they might have.*

Accountability shifted away from peers to the problem subject in PBL Problem 4 with an increasing number of statements noting accountability toward the problem subject and those individuals affected by their recommendations (i.e., graduate students, patients). In this final problem, students described how their sense of responsibility and urgency for finding a solution was connected to the solution having an immediate value and utility for the clinic director, who had presented her concerns and heard their recommendations in face-to-face interactions with the students. The following student statement is an example of the impact of this interaction.

> *Presenting our recommendations in front of (clinic director) also affected my learning experience. It was both challenging and motivating to provide a recommendation for an existing problem at the (university clinic). I hope our class's research and recommendations were able to help in the process of purchasing instrumentation*. (Hannah)

The following statement by Lisa is also an example of students identifying personal relevance and future accountability for themselves.

> *The fact that I may one day use the applications (as a graduate student) and software that was recommended during class also helped me stay interested throughout the module, as I wanted to make sure that I would recommend something that I would both want to use and find helpful in a couple of years.* (Lisa)

The category of perceived problem value was the most frequent category identified (35% of students) in the development of this theme. Importance, meaningfulness, authenticity/realism, and utility were codes related to the perceived value of the problem. This meaningful aspect was articulated by Anna in her statement regarding her group's presentation of their recommendation, "*I found this learning artifact to be the most interesting because I felt as if our recommendation actually mattered.*" She expanded on this statement by stating, "*The research that we were doing was going to benefit the clinic and classroom setting and something about that idea is really cool!*". This sense of importance and value was also explicit in Sue's statement. "*This module also aligned with my own personal interests in the way that I felt that my opinion was actually pretty important.*"**.**

Although, the problem subject for each of the last three modules also used a real person and authentic clinical scenario in the problem design, the realism provided by the face-to-face interaction and the familiar problem setting of the on-campus university clinic was noted by students in their reflections, as exemplified by Gina's statement. "*What affected my motivation the most was definitely how 'real-life' this problem was. We had a real clinic goal in mind the whole time we researched, so this made the experience very real to us.*" The face-to-face interaction may have fostered a sense of immediate applicability of the problem scenario to the

problem subject, familiar peers (i.e., graduate students), and familiar setting (i.e., university clinic); therefore, providing a sense of ownership and personal responsibility for engaging in problem solving. Students described their ability to envision their recommendations being applied to a familiar setting and peer group as motivating. For example, Allison said: *"For me, having a PBL with immediate impact was very motivating. Knowing that recommendations for this PBL could potentially be used in our clinic made me want to get as much information as possible to make as accurate recommendation as possible*." This sentiment was also presented by Audrey in these statements: "*I also thought that because we felt like we were doing something that was helping in the real time it was more motivating*" and "*Since I work in the clinic I see every day what is going on and how these new devices could benefit our clinic as a whole. I think that this motivated me to want to work harder to learn more from this module.*" Students recognized the role their problem solution recommendations would play in their immediate surroundings and future settings. This sentiment was captured in with the following reflection.

> *Knowing that our recommendations would be taken into consideration for future clinic and class purposes did influence how I handled my responsibilities for the project. It took the module from being a more casual research project to a more thorough look into the options we found. It increased the pressure and influenced me to be more critical with the choices I made with what I brought to the group.* (Mary)

These statements are suggestive of accountability during with a face-to-face interaction as a subject presentation type identified within this theme. It is possible the frequency counts of engagement behaviors during the final problem did not fully capture the quality of student engagement or the underlying interest and motivation for the problem scenario.

Although the quantitative data showed a decline in frequency in observable engagement behaviors overall with the face-to-face interaction of the final PBL module, the cumulative perspectives of the students from the final course written reflections (i.e., after PBL concluded) provide a different impression overall with 17/46 (37%) students retrospectively indicating PBL Problem 4 (i.e., Level 4: real subject, face-to-face interaction) being the problem they found the most motivating for their engagement as shown in Figure 12.

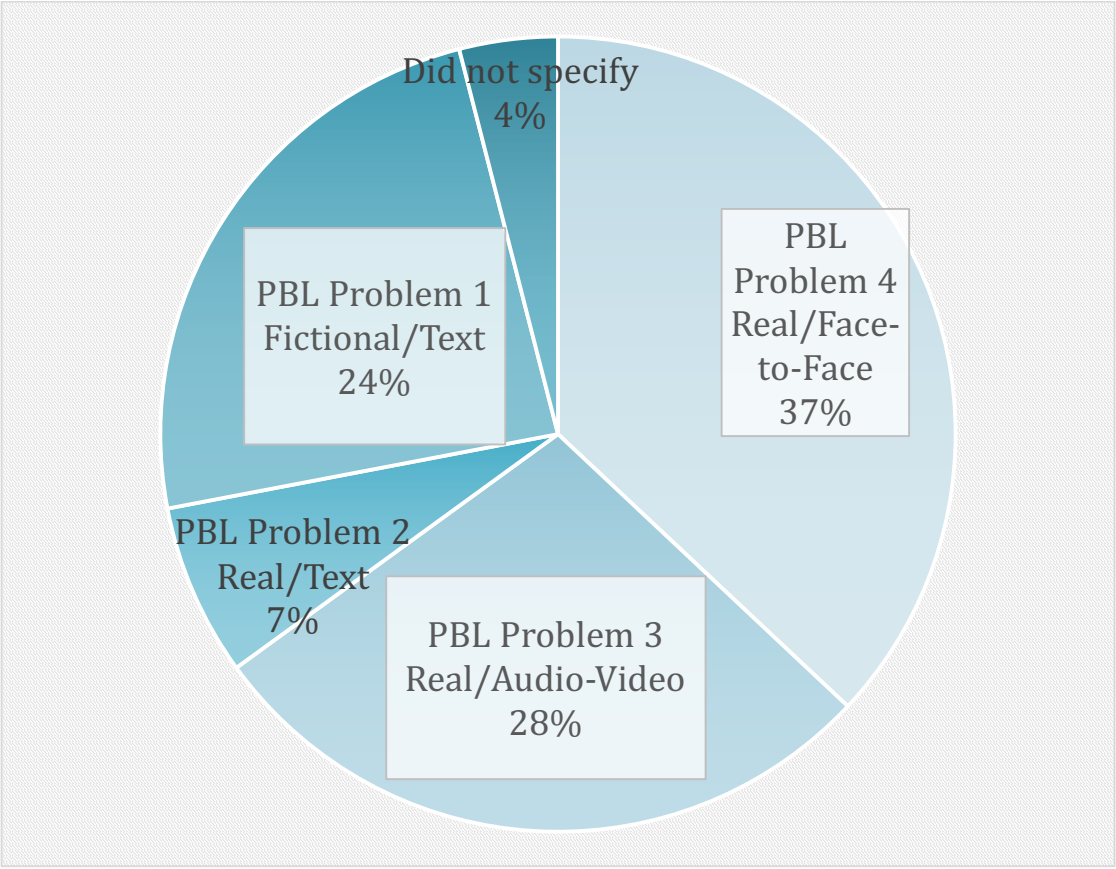

Figure 12. Student Designation of PBL Problem Providing the Highest Motivation from Final Course Reflection. *Note*: $n = 46$.

The following student reflection statement supports with this observation that engagement may still have been strong and occurring possibly outside of the classroom, even in the final PBL module when fatigue with problem solving may have been present as suggested by the decline in the observed frequency of engagement behaviors from the quantitative data.

I would say that Module 4 was the most motivating for me…Since we were researching something that could potentially have a have an impact on what the clinic was going to choose as an option for instrumentation, I wanted to be as diligent as possible in making recommendations. Since my group split up what we were each researching, it made it that much more important to communicate with one another what our specific findings were. This helped us to engage and stay engaged with one another. (Beth)

Some students identified another PBL module using a real problem subject as more motivating. As previously depicted (see Figure 12), 13 of 46 (28%) students identified the PBL Problem 3 (i.e., real subject, audio-visual) as the most motivating in their final course reflection summary. This finding is of importance since the quantitative data portrayed the engagement levels for this module as the lowest of all of the subject presentation types and students identified this as very challenging content in Theme 2, yet it was designated as more motivating than the two PBL problems with the highest observed levels of engagement overall (i.e., PBL Problems 1 and 2). In considering the research question once again with regard to these final student reflections—how does the subject presentation type of problem scenario affect student motivation during the PBL instructional process? —the problems using a presentation type with a higher degree of social presence (i.e., audio-visual and face-to-face) were preferred by a majority of students (65%) as compared to the text based presentations (35%).

A final theme emerged from the qualitative data providing insight on factors that were facilitative for students experiencing PBL within this Speech and Voice Science. This theme does not directly relate to a specific research question; however, it may provide a more nuanced understanding of the learning environment and the specific implementation of PBL for this Speech and Voice Science course.

Theme 5 Group dynamics and PBL supports (i.e., assigned roles, learning artifacts) fostered a positive learning experience. The PBL structure appeared to provide a shared focus for student engagement via the embedded structure of PBL: assigned roles, trigger questions, peer teaching, and group reporting. The experience pertaining to the effect of roles on engagement was described this way by one student:

> *I do believe that our most motivating topic for discussion and individual research was (*PBL3*). That was the first PBL our group had figured out roles in the group. For example, Mary spoke well in front of audiences so she became one of our leaders in that area. Others, such as Jane provided very detailed research for her assigned aspect for the PBL. Having figured out the roles in the group helped us become more efficient in this PBL. We were able to have more in depth discussions to figure out the content needed to determine our recommendations for this* (Sophie)

Jan provided an example of how the group dynamic in PBL was instrumental for her learning: "*In regard to module one, the team really helped me pull the content together and understand it in a new and different ways."* She also stated: "*The only disadvantage I can think of (for PBL) would be if a group member was not participating in the fullest. Luckily for me and my group we never had that problem*." Although Jan described no problems within her group dynamic, she was cognizant of how the dynamic, if poor, could have created an obstacle to her learning. Positive peer group dynamics appeared to develop gradually over time, supporting students during initial apprehension for PBL process and later during the challenges of problems with difficult domain content and complexity. An example of a statement supporting this is as follows:

> *My prior experience with working with groups in general has not been good. The aspects we use in the PBL, allows each and every one of us to take part. I also was very lucky to have such an amazing group. My learning experience was successful because of the interacting of the group."* (Julie)

Another student, Jenny, identified a concern that was periodic in final course reflections and relevant to a potential threat to content mastery with a PBL instructional approach.

> *Working in a group setting was good, because I think it better prepared me for working in a team-based setting with other professionals in the future. I also like that we could divide the work so every person was responsible for learning a specific concept of the module, and then teach that to the other members of the group. I also saw this as a disadvantage, because I sometimes did not feel that I had a firm grasp on concepts that were not my responsibility to research in the group.* (Jenny)

The shared group assignments (i.e., learning artifact, collaboration tools) used within this PBL course implementation were also mentioned as a facilitative and a way to reinforce understanding of concepts. This was expressed the following statement by Emily describing how their group made sense of their research for engaging in discussion and decision-making by planning and constructing a learning artifact to present to their peers: "*I loved our artifact format for that module (Poster Board) and feel that we were able to consolidate a large amount of rote knowledge into a relevant and useful format."* The learning artifacts were intended to provide another form of formative assessment on content mastery for the course. The most frequently used artifact type was a shared Google® document, which allowed students to simultaneously share and edit content and also create media presentations. However, as the semester progressed students experimented with other ways to organize and share content in the group, which may

have had an impact on motivation. For example, Kris stated "*It was exciting to see our research presented as a website our group designed and created"*. Student exploration with other active learning collaborative tools were described by Lisa and Shannon.

> *Another aspect that kept us engaged was using a Prezi as a learning artifact. None of us were entirely familiar with this form of presentation but it helped us work together and communicate as a group throughout the class period. The Prezi kept me motivated to learn how the program worked, along with the information going onto our learning artifact.* (Lisa)
>
> *This (Google® learning artifact) has been an effective way of keeping us all accountable for being a good member of the group. I think using a different learning artifact for each module also creates motivation for us as well, because we have to adjust to it each time.* (Shannon)

It is possible the autonomy and control students experienced in making decisions about how to demonstrate their learning through learning artifact choices and development were supportive of positive group dynamics. The interaction of positive group dynamics and experimentation with different active learning collaborative tools appeared to complement the PBL structure in supporting students in this course.

Other findings. In their final reflection assignment, students were asked to identify a course-learning outcome they had mastered and describe what they had learned, providing some additional insight into content mastery and effectiveness of PBL for Speech and Voice Science. A frequent student-learning outcome cited by students was the objective to understand the different roles of articulation, phonation, respiration, and resonance for the production of speech, which is a primary course learning outcome for this Speech and Voice Science course. Ella

described her mastery of this outcome in the following way: "*In previous courses, I mostly just categorized these components altogether in forming speech, but I had never individually gone through each system and identified its contribution to speech. I feel more confident in explaining the different parts of speech to someone who is unfamiliar with the process.*" It is possible that the PBL process helped solidify the connections between speech science concepts by allowing the students to identify the concepts from the perspective of applied scenario, rather than from the perspective on the content only. This is supportive of PBL contributing to an effective mastery of this course content knowledge by her ability to synthesize the information. Laura expressed her perception of content mastery in the following statement: "*I feel I have gained knowledge about every single learning objective listed on the syllabus*." She also said, "*There were a few that are still a little foggy to me, but I feel that I really grasped the anatomy and the way the articulators and other structures work when dealing with speech.*" Another student described her ability to connect mastery of Speech and Voice Science learning outcomes to content from other courses.

> *I had used spectrograms in physics of music last semester, but hadn't understood how they work. Now I can see what is happening and how to actually read one, all last semester I just pretended and somehow, I made it through. I gained my understanding by reading sections in the book, researched some online, and found short you tube videos explaining the analysis of speech and voice on spectrograms. In our group, we shared our research findings and everyone has a different way of explaining things, so the different perspectives increased my knowledge even more*. (Shari)

Shari's reflection provides insight into how her content mastery gradually evolved and also a reflection of the positive aspects of her PBL learning experience. Some students identified some

non-content related aspects of learning as successful learning outcomes. For example, Jill stated: "*I think the course learning objectives that I was most successful with were the self-directed learning skills, and the problem-solving skills.*", highlighting a positive learning benefit unrelated to the course content, although an important rationale for using PBL as an instructional approach. She also indicated that perhaps the depth of her knowledge in specific topics could have been improved. "*The only downfall I would say with a PBL class, we each did our own piece of research, but didn't always individually learn each aspect of the module that we should have been.*" This aspect could provide some insight into the lower exam scores in the final content assessment for factual knowledge. A division of research responsibilities may have limited the depth and breadth of specific factual concepts and the lack of a final assessment on PBL problem may also limited a full understanding of content mastery gained from this PBL implementation.

Although some concerns about the difficulty of content knowledge and group dynamics were raised in the final written reflections, the majority of students described their first PBL learning experience and its role in this Speech and Voice Science course optimistically. An especially positive reflection on impact of the experience by Ann describes the PBL experience overall.

> *I can barely explain how much this (course) has impacted me as a learner and the way that it has challenged me to think like a clinician and a therapist. I have learned so much, I have realized another way in which I can learn, and it being in a group made my mind that much more powerful in the end because just me alone, I can only think so much about certain things by myself, so it was great combining our minds to tackle these situations together."* (Ann)

Although not a direct measure of factual knowledge, the student reflections identified signs students were recognizing the value of understanding speech and voice science concepts, especially from the perspective of applied knowledge and the importance of developing problem-solving abilities for future clinical decision making as noted below.

> *The PBL experience is a great way for students to learn. We learned from our group members, other groups and the professors… Many classes present the information without allowing us to apply it to any potential clients. Learning this way made the students of the course more independent because they had to research the topics, be able to relay that information to others and apply it to a client. Learning this way made the knowledge of speech science more useful as a future clinician."* (Sophie)

Sophie identified she was developing proficiency with becoming a self-directed learner while learning how to apply her content knowledge, an important learning outcome for this Speech and Voice Science course.

Summary

This chapter summarized the initial quantitative data for frequency of observed student engagement behaviors from classroom observations across four consecutive PBL problems representing different levels of subject presence for the subject presentation type independent variable for this study. It also presented the findings of the assessment data for content mastery. Further analysis of qualitative data from student learning artifacts and investigator field notes provided qualitative themes describing patterns, which informed the analysis of the quantitative data from the perspectives of the students and investigator. The final chapter provides additional interpretation, implications, and limitations of the data analysis of the study findings.

CHAPTER V

DISCUSSION

This chapter will discuss the possible interpretations of the overall findings of the study and specifically consider each of the study's research questions. The key finding from the quantitative data was an overall decreasing trend in the frequency of observable engagement behaviors across the four different levels of subject presentation type, which seems to support the fatigue hypothesis discussed in Chapter II (Czabanowska et al., 2012; Hung et al., 2013). This decline—primarily in verbal engagement behaviors—was observed despite the use of different levels of subject presentation type (e.g., face-to-face interaction) and authenticity (e.g., real subject), meant to increase social presence in the PBL problems. The frequency of individual nonverbal researching electronic media behavior and nonverbal organizing actions increased steadily across all four PBL problems suggesting a shift in the nature of engagement.
Most students described the final two problems as being the most motivating problems in the qualitative findings. This occurred despite the declining frequency of overall engagement behaviors and increasing content difficulty and problem complexity. This could suggest the nature of the engagement behavior may vary as an artifact of variables within the problem design, potentially providing an argument that engagement did not decline as sharply as shown in the initial quantitative findings. Thus, there may be some support for the suggestion that the subject presentation types using higher levels of social presence (i.e., face-to-face interaction) did provide value for maintaining students' motivation.

The PBL subject presentation format (i.e., face-to-face interaction) of the key problem character involved in the problem, when used in combination with affective characteristics and career related elements purposefully embedded through problem design, may support student

motivation throughout the challenges of PBL. Considering the frequency of verbal behaviors alone may not connect one to significance or benefit of using an involved, actual person as the key character presenting a PBL problem. The students' perspectives, however, added value to the problem design variable of subject presentation type.

Hung (2016) emphasized the central role of the problem in PBL and this was supported by the consistent frequency of students connecting their reflections on motivation back to the PBL problem and/or subject characteristics because of relatedness. The perceived value of problem solution and direct face-to-face interaction with the problem subject was identified as meaningful by students, creating urgency, purpose, and an interest to engage in research for problem-solving. The perceived value of finding a solution that would serve the university clinic aligns with the immediacy and intimacy dimensions of the social presence construct (Short et al., 1976) for potentially enhancing motivation. It is possible that the benefit of students realizing the connection to their future career aspirations creates an additional reason to sustain effort, supporting motivation. These elements may possibly counteract some potential threats to the effectiveness and fidelity of PBL described in the literature including: declining quality of PBL behaviors (Dolmans et al., 2001; Moust et al., 2005), varied cognitive development levels for students (Czabanowska et al., 2012; Keegan et al, 2017a), PBL fatigue (Czabanowska et al., 2012; Hung et al., 2013) and generalized student fatigue (Beard et al., 2005). Qualitative data analysis also identified the transition to more difficult and less familiar content increased stress for some students but sparked curiosity and interest for others. The decreasing frequency of overall engagement behaviors in challenging PBL problems does not necessarily mean that motivation was not present or the students were not acquiring knowledge. The transition to a

more difficult and less familiar content may have, however, overshadowed the anticipated effect of increasing social presence on engagement levels in the quantitative data.

A discussion is now presented for each of the research questions to integrate these quantitative and qualitative findings, and provide further conjecture of the results by considering previous findings in the literature. This discussion also includes potential implications for future PBL problem design considerations and the implications for PBL gaining momentum within the discipline of Speech Language Pathology (SLP). Other implications for PBL design, study limitations, and recommendations for future research are also discussed.

Research Question 1: How does the subject presentation type of problem scenario (e.g., a real person who is involved in the problem case) within a PBL problem scenario affect student motivation measured by levels of student engagement during the PBL instructional process?

It was anticipated that student motivation as measured by engagement level would be the highest when working on a problem presented by a real person who was involved with the problem (i.e., a maximum level of social presence). The quantitative data on its own did not support this idea, but it did demonstrate different levels of engagement with each change in the level of subject presentation type. It was PBL Problem 2 (i.e., a real subject presented via written text) that unexpectedly had the highest level of engagement (2816 frequency count) despite having a subject presentation type with a lower level of social presence (i.e., text). Additionally, the quantitative findings showed an overall declining trend for engagement levels as the subject presentation type transitioned from low (text) in PBL Problem 2 to the high (audio-visual and face-to-face) social presence in PBL Problems 3 and 4. This downward trend, however, may not necessarily represent the full picture of the dynamics of engagement and

motivation for the students of this study. The qualitative findings provided an interesting portrayal of how the subject presentation types with higher levels of social presence were perceived by students. Rather than expressing a declining motivation level for the final two PBL problems to align with the quantitative findings, most students retrospectively identified their motivation as being highest in the PBL Problem 4 (37%) followed by PBL Problem 3 (28%). These two problems were designed to have the higher levels of social presence (i.e., audio-visual and face-to-face interaction) to foster motivation. Students identified PBL Problem 1 with the third highest frequency (24%) and the fewest number of students (7%) selected PBL Problem 2 (7%). This result is juxtaposed suggesting the relationship between engagement and motivation was multifaceted for the students in this study.

As mentioned earlier, one possible interpretation of this disparity could be that the subject presentation type using a face-to-face interaction did have some effect on the problem design and influenced students' motivation, given the positive preferences expressed by students and identification by the most students (37%) as the most motivating problem from the qualitative data. This may also explain why the declining engagement trend stabilized with the PBL Problem 4 (i.e., face-to-face interaction). Other possible interpretations and discussions related to this question from the previous findings follow, including: fatigue with the PBL process itself, shifting engagement with variations in levels of prior knowledge, content difficult, and problem complexity, the novelty effect of PBL or problem presentation order, and the changing nature of student accountability.

Fatigue with the PBL Process. Since PBL is a student-directed, active learning instructional approach, the overall declining trend of engagement may have been a consequence of the students experiencing fatigue with repeated exposure to successive PBL problems that

required increased effort and participation levels as previously discussed in Chapter II. The investigator field notes did describe students expending effort and following PBL steps systematically, especially in the initial two PBL problems. Concerns about fatigue developing was one reason that subject presentation levels with increasing levels of social presence were used in this study as fatigue with PBL format was considered a potential threat to PBL effectiveness (Czabanowska et al., 2012; Hung et al., 2013). The onset of decline in overall frequency of engagement behaviors coincided with PBL Problem 3 (2022 frequency count), representing a significant decline from PBL Problem 2 (2816 frequency count). One sign of fatigue could be the observation that students were being less diligent about the PBL steps and the suggested problem-solving activities (i.e., answering trigger question, using roles). As discussed previously, this decline in is similar to behaviors reported in several studies (e.g. Dolmans et al, 2001; Romito & Eckert, 2011; Moust et al., 2005).

It is plausible that fatigue could have ensued as a consequence of students initially engaging at an especially high level and that effort may have been difficult to maintain with the same intensity over time. The investigator did observe students skipping assigning specific roles or adapting their roles to the preference of their group dynamic. This adaptation may have added efficiency in the presence of fatigue. However, it also eliminated the roles that facilitate verbal engagement behaviors of questioning and commenting (i.e., chairperson, quality monitor). As noted in Chapter IV, even when roles were assigned they may not be fulfilling their intended functions. If students were experiencing fatigue, it is reasonable to consider that they would seek ways to streamline or simply to process (i.e., skip or modify PBL steps) or even fail to fulfill the duties of the role and therefore eliminate or modify an intended PBL support. Nevertheless, the consequence could be it would likely result in lower levels of verbal engagement behaviors when

the supports intended to facilitate discussion were bypassed. This interpretation would be consistent with concerns regarding the PBL erosion described by Czabanowska et al. (2012) and Moust, et al. (2005); repeated PBL experiences over time are susceptible to having PBL steps that are not attended to as strictly over time. It also aligns with concerns raised by Lim (2002) that modifications to the PBL structure nullify some of the benefits of PBL approach. Lim was primarily concerned with the faithfulness of the PBL approach to a pure, rather than hybrid model of combined lectures, yet he was also concerned with PBL fidelity. For example, there may be a changing nature of actions by the instructor and students that sometimes occurs in response to the demands of a pure PBL implementation. In this research, the format and structure of the PBL approach was consistent, but a loss of fidelity to the PBL steps may have contributed to the changing nature of engagement that was observed in the final PBL problems.

The finding that the engagement level increased slightly from PBL Problem 3 to PBL Problem 4 may also be interpreted as a boost in the students' motivation to counter the fatigue developed among students. The downward trend for total engagement behaviors was stabilized and reversed in PBL Problem 4. The PBL Problem 4 had the highest social presence using a real subject and face-to-face interaction as its subject presentation type. The data showed a slightly higher level of engagement behaviors (2118 frequency count) in this problem than in the PBL Problem 3 (2022 frequency count) using an audio-visual presentation, yet both are higher social presence. This is consistent with the benefits of integrating real people in the PBL experience described by Li et al. (2013), Yoon et al. (2016), and Keegan et al. (2017a). One may postulate whether or not the negative trend would have continued to decline per the overall trend if there had been no change in the subject presentation type, although there may also have been other factors related to fatigue in general.

Generalized student fatigue. One possible overall interpretation of the decline could be the presence of generalized student fatigue that may occur over the course of a semester or a declining interest in academic work regardless of the learning approach used. This research did span across 8 weeks within a semester and the two problems with lower levels of engagement did occur after the midpoint of the semester. This interpretation does align with the student perspectives provided by Beard et al. (2005) of first year students in a university setting, describing fatigue as a significant factor in their learning experience. However, in the piece by Beard et al. (2005) they describe general fatigue as a generalized college experience and not associated with any one factor within a specific course construction. General fatigue is a plausible explanation for some of the decline specific to this study, yet it does not explain why some engagement behaviors increased (i.e., nonverbal researching) and attendance remained high. In addition, the fatigue described by first year students in the Beard et al. study does not align directly with the characteristics of students in this research, who were primarily in their final year in the university setting.

Being in the final year of college however, may be a contributing factor to declining engagement levels. For example, it is plausible that engagement and effort diminished as consequence of deteriorating interest or distractions related to the anticipation of upcoming graduation. This explanation, however, was not specifically expressed by students, rather the reflections from students and observations of the investigator were supportive of sustained, rather than diminishing efforts. The investigator's prior experiences of working with students from this major also align with continued effort being present as students typically demonstrate an elevated level of concern for earning high grades because of a competitive application process for SLP graduate programs. Concern for grades is an example of extrinsic motivation, which

also may explain continuing effort over time. However, if general fatigue was a factor, one may argue that student participation via attendance would have also likely declined. Student attendance, however, did not drop off in PBL Problems 3 and 4, with 95% and 96% attendance rates respectively. If the students were experiencing generalized fatigue, low motivation, or apathy in their final semester before graduation, one may expect lower participation and less (rather than more) involvement in nonverbal researching activities. Attendance was not a required element associated with points in the course, however, it was strongly encouraged. Students did complete a peer evaluation of participation for a small number of points, potentially providing another extrinsic source of motivation.

The finding that most students retrospectively indicated their motivation for engagement was higher for the two problems that used presentation types with higher levels of social presence (PBL Problem 3 and PBL Problem 4) in the presence of declining engagement behaviors observed, may be better served by discussing studies using PBL learning environments to provide a similar experience from which to consider interpretations. For example, there are some similarities to the Li et al. (2013) conclusion for medical students in a Chinese dermatology course. Student perceptions of the different PBL presentations in their study demonstrated a preference for real patients and digital media formats. This aligns with Theme 4 in this study, where direct interaction with problem subject and high solution value enhanced accountability and realism. Yoon et al. (2016) also concluded the interaction in real-time with an actual person was advantageous to other formats (e.g., paper, audiotapes), which would support the interpretation that it is possible to have motivation levels that vary with the subject presentation type. The subject presentation type using a face-to-face interaction (i.e., high social presence) appeared to foster motivation by providing students with a high level of accountability,

especially in PBL Problem 4 as characterized by a sense of problem ownership and responsibility to the problem subject—the university clinic director. This result supports the finding by Hung et al. (2013), where students developed ownership of their problems by directly interacting with a problem subject. As previously discussed in Chapter II, there has been value associated with the use of real subjects in the PBL literature, whether through the use of standardized patients (Yoon et al., 2016), real subjects or patients (Dammers et al., 2001, Hung et al., 2013) or adding interactions with individuals with similar clinical issues to complement the PBL process (Keegan et al., 2017a).

Another interpretation may be that by the time students were working on PBL Problem 4, they may have developed improved problem-solving skills, collaboration ability, and efficiency in their communication skills as they progressed through each of the four problems, rather than declining motivation because of fatigue. This may help explain the downward trend in frequency of observed verbal engagement behaviors. Increasing levels of competence and efficiency with PBL would likely change the dynamics and combinations of different engagement behaviors. For example, the time spent on talking (i.e., verbal engagement) and problem-solving brainstorming may have decreased and non-verbal researching and organizing behaviors increased. The duration of these non-verbal behaviors was not monitored, which would help fully understand this potential explanation. These behaviors (i.e., contemplation, researching, organizing), however, are examples of appropriate and necessary types of engagement for problem solving. While these interpretations may help explain the findings, it is important to fully consider other possibilities. For example, it is also possible the interaction with low prior knowledge or difficulty with content knowledge exacerbated fatigue or affected motivation.

Engagement behaviors varied with levels of prior knowledge. Levels of prior knowledge were anticipated in this PBL course design to vary across PBL problems and this may have contributed to the different levels of engagement behaviors observed across the problems. PBL Problem 1 (Speech breathing) was designed to be of moderate difficulty using overlapping prior knowledge from prerequisite anatomy and physiology coursework in its design. PBL Problem 2 (Phonation) also had a moderate difficulty level, however, it used overlapping knowledge from both prerequisite coursework and from PBL Problem 1. This aspect of the PBL design likely provided scaffolding to support the learner, which Czbanowska (2012) described as important for counteracting PBL fatigue. One could argue that the overlap in content knowledge embedded in the problem design using the 2nd generation 3C3R framework (Hung, in press) fostered and supported learners in the early PBL problems, yet the problem design may not have sufficiently offset the different levels of prior knowledge or stages of cognitive development (Czbanowska, 2012; Keegan et al., 2017a) that the students had at the onset or during the PBL experience. The individual design decisions guided by the problem design model pertaining to content also appear to be significant for constructing a sequence of problems, which has implications for overall curriculum design and content mastery. This overlapping prior knowledge may help explain the unexpected higher levels of engagement for the initial two subject presentation types (i.e., text) with the lowest social presence. This aligns with the overall increase in engagement observed for PBL Problem 2 (2816 frequency count) when compared to the initial problem (2511 frequency count). It may have been easier for students to engage with higher frequency when they had more knowledge to draw upon or had more feelings of confidence about sharing their prior knowledge based on their newly acquired knowledge from the prior PBL problem. This aligns with the competency aspect of the SDT of motivation (Ryan

and Deci, 2000a). It is, therefore, possible that there was an effect observed in the first two problems stemming from students having more prior knowledge accessible from prior courses in the curriculum and the PBL design of the problem.

This overlap in prior knowledge was not as significant and obvious for PBL Problem 3, the problem where the engagement levels declined to their lowest point (2022 frequency count). The content knowledge for this problem was focused on speech acoustics. This problem did require prior content knowledge from prerequisite phonetics and articulation courses, however, it would not have been as immediate and as recent of an experience as the connection as between PBL Problem 1 and PBL Problem 2 that linked speech breathing and phonation. Several students also identified they were taking the prerequisite anatomy and physiology course simultaneously with this course, which provides a significant amount of prior knowledge for these initial two problems. This likely made the prior knowledge for some students more immediate and accessible for problem solving. For PBL Problem 3 (i.e., Speech Acoustics) students would have had to access knowledge from other prior prerequisite courses that occurred earlier in their curriculum, but they would not have had an overlap in significant domain knowledge from the last problem they most recently had completed. Boyce (2016) discussed how the terminology used in speech science concepts has the potential to cause confusion among students. Confusion around terminology of the more difficult speech science concepts in PBL Problems 3 and 4 may have contributed to a decline in verbal discussions.

Low prior knowledge on the instrumentation options necessary for addressing PBL Problem 4 also could have contributed to the overall trend in declining engagement. Students bringing less prior experience with instrumentation options may have been less able to engage in discussion to the degree they did in the initial two PBL problems until they gained knowledge to

initiate brainstorming and discussion. This lower engagement may have been grounded in the students' need to become more self-directed during the final problem as it was more open-ended and ill-structured. Hung (2011) described the combination of self-directed learning and ill-structured problems in pure PBL as facilitative for developing self-directed learning, a desired benefit of PBL. Yet, if the students' prior knowledge in PBL Problems 3 and 4 was low, they may have struggled with generating questions and lack necessary content knowledge to engage in the reasoning tasks are associated with being a self-directed learner. This would also have been captured as low frequency of verbal engagement behaviors. Czbanowska et al. (2012) also raised a related aspect of becoming a self-directed learner that is important to consider when discussing the impact of prior knowledge. They had described how developmental stage of the cognitive processes of young adults is on a continuum. It is unlikely that all of the students in this study would have had the same levels of self-directed learning capacities or higher order cognitive abilities. Keegan et al. (2017a) also discussed the relevance of different stages of learning, noting that although PBL supports reasoning development, students at the undergraduate level may not yet be in relativist stages of looking at problems from multiple perspectives or at a dialectical stage requiring the ability to appraise, argue and defend ideas. Rather they may still be in an absolutist stage, relying on authority figures for evaluation of ideas and solution. The open-ended nature of PBL Problem 4 did require students to make decisions and recommendations based on their ability to reason and evaluate instrumentation options. It is reasonable to consider fatigue or a lower motivation to engage would emerge when faced with less familiar content that was beyond their cognitive development levels of reasoning. This may be true if the cognitive load for these activities was high, which was the case with the final PBL problems within this study.

Engagement behaviors varied with levels of content difficulty. PBL Problem 3 also added new concept knowledge related to acoustics, which was expected to be challenging based on the investigators' prior experiences with teaching the content and as identified through the PBL problem design process. As a result, this problem was labeled as difficult in the design phase. For this reason, it used a higher subject presentation level anticipated to trigger authenticity and increase social presence (i.e., Level 3—audio-visual). The qualitative findings demonstrated that this was indeed an appropriate label—aligning with the quantitative decrease in engagement levels, however, it also identified how students responded to the difficulty**.** The addition of stress from lack of prior content knowledge may have played a role in the drop of engagement to its lowest point in the study that was observed in PBL Problem 3 (2022 frequency count), possibly overshadowing the intended benefit of increased social presence. It is possible that the difficulty of the domain knowledge of PBL Problem 3, although ill-structured on the continuum of structuredness for PBL problems (Barrows, 1986, Hung, 2011), resulted in a lower level of self-directedness since the complexity demanded more questions directed to the tutor in order for students to understand concepts necessary for reasoning tasks. This would also align with the concerns raised by Czbanowska et al. (2012) related to potentially variable capacities for higher order cognitive abilities and different levels of adult learning development. As previously discussed, Keegan et al. (2017) also had noted that while PBL provides an opportunity for adult learners to be involved in their learning, they cautioned that undergraduates may be performing at different stages of reasoning. This appears to evident in the observed behaviors of students seeking assurances from the instructor as the problems became less-structured as was the case for PBL Problems 3 and 4. The investigator field notes described more time being spent providing reassurance to students about the steps they were taking to understand

content, which may indicate that students may have needed more support from the facilitator with difficult content to align with their cognitive development as an adult learner, but not necessarily that they were less engaged. One possibility could be they may have been less likely to engage with peers in PBL Problem 3 and PBL Problem 4 if they were not confident with their understanding of the domain knowledge, found it confusing, or were not clear with the explanations they were receiving from their peers. As a result, it would be difficult for students to demonstrate the highest levels of self-directedness, that are typically described as pure PBL problems in Barrows' (1986) taxonomy and could contribute to a decline in the fidelity of the PBL process.

Although the PBL Problem 3 had elements in its design that Ryan and Deci (2000b) identified as necessary in their self-determination theory of motivation, psychological connection (i.e., personal interest and career relatedness) and autonomy (i.e., students engaging in self-directed learning activities), the PBL problem design may have fallen short in the competency aspect by incorrectly anticipating the amount of prior knowledge needed for students to start the problem-solving process. One hint of this originated with students commenting with variations of "I didn't know where to start" and the investigator's perception that students were asking more specific questions to clarify their understanding of concepts. For these students, the competency aspect of the self-determination theory of motivation (Ryan and Deci, 2000a) may have been threatened.

The decreasing frequency of overall engagement behaviors in challenging PBL problems does not necessarily mean that motivation was not present or the students were not acquiring content knowledge through the PBL process during this PBL problem. The students' lower prior knowledge logically required them to engage in more researching behaviors and less verbal

communication. This conjuncture seems to align with an overall trend of increase of the students' research behaviors during the course of four PBL problems, which reached its peak with PBL Problem 4 (197 behaviors).

Some students responded positively to the challenge of content difficulty. This connects to the statement from Ryan and Deci (2000a) where they describe intrinsic motivation as "the inherent tendency to seek out novelty and challenges, to extend and exercise one's capacities, to explore, and to learn" (p. 70). The interest in PBL Problem 3 also aligns with the conclusion by Sockalingam and Schmidt (2011) that students favored PBL problems leading to learning issues and problems that triggered interest or curiosity. PBL Problem 3 appears to have provided a context for intrinsic motivation to develop for some students despite it being considered the most difficult by many students, initially frustrating, and having the lowest observed levels of engagement behaviors.

The interaction between content difficulty and problem complexity. There are many possible variables and variations of PBL designs and implementation methods described in the PBL literature (Albanese & Mitchell, 1993; Barrow, 1986; Hmelo-Silver, 2015; Hung, 2016). It is also important for problems to have the right combinations of complexity and challenging aspects for engagement (Jonassen and Hung, 2015). Using ill-structured problems to with variable problem solutions is a characteristic of PBL (Schmidt, 1983) and contributes to problem difficulty and complexity. The first two PBL problems were designed around clinical communication disorders (i.e., Speech Breathing and Voice Disorder), and solutions were constrained somewhat by the best practices of clinical content knowledge for assessment and treatment of this clinical communication disorders. PBL Problem 3 applied domain knowledge of speech acoustics (i.e., elective accent modification) to questions about whether or not speech

acoustics would be an appropriate therapy tool. PBL Problem 4 required the application and synthesis of speech acoustic domain knowledge to evaluate and recommend acoustic instrumentation. As a result, the problem design of PBL Problem 3, and to a greater extent PBL Problem 4, differed from the previous problems by seeking problem solutions that had a more pronounced, unsolved nature. When combined with elements of content difficulty and problem complexity previously discussed, the interaction may help explain the changing dynamic of engagement from being primarily active (i.e., questioning) to more reflective (i.e., researching, contemplating) as identified in Theme 3. The novelty of engaging in PBL and/or the order in which the problems were presented to students could also be a factor for interpreting the variations in engagement across problems.

Novelty effect of PBL and problem presentation order. The initial high levels of engagement in the initial two PBL problems could also have been produced as a consequence of the novelty of the instructional method. Pintrich (2003) also provided novelty as being associated with increased levels of intrinsic motivation. The PBL process was a new and an unfamiliar instructional approach for all of the students. Therefore, the novelty factor described by Ryan and Deci (2000a) and Pintrich (2003) may account for a higher engagement levels early in the course. The novelty of the PBL process may have motivated students to engage differently in the different subject presentation levels than they would have if they had been experienced PBL users. This interpretation would explain the data showing the highest frequency of engagement behaviors occurred in the non-face-to-face interaction of PBL Problem 2. During PBL Problem 2, students were observed by the investigator to be adhering to the PBL steps and using the assigned roles with regularity. They were using the provided written prompts to facilitate in brainstorming and were familiar with the duties of each PBL role. This likely generated a high

level of verbal engagement as they were more systematic in following steps. As a new instructional approach the novelty may have directed students to use these supports to offset their uncertainty for PBL as an instructional approach. These PBL elements were intended to help foster learning by providing a shared focus for engagement. It is a reasonable assumption that the steps designed to help students develop questioning and brainstorming skills would result in a high level of verbal engagement behaviors (e.g., commenting, questioning). The PBL process was likely still novel for most students in the PBL Problem 2. Yet engagement in PBL Problem 2 may have been elevated even more with increasing familiarity and comfort with the PBL steps. Katie's statement from the qualitative data presented in Chapter IV highlights the shifting comfort with the PBL process, *"When our group started discussing this case (PBL Problem 2) we were pleasantly surprised at how much it was easier this time around*. This speculation highlights the potentially intertwined nature of novelty and changing comfort levels with PBL.

Shifting engagement behaviors. While total engagement had a negative trend, the analysis of the patterns of individual engagement behaviors (i.e., verbal and nonverbal) across the subject presentation types provides an indication as to how students could describe strong motivation in the final two PBL problems while actually demonstrating fewer engagement behaviors. The increase in some of the individual non-verbal behaviors over the course of the four PBL problems provides some indication of a shifting nature of engagement, which was further supported by Theme 3 from the qualitative findings: the nature of engagement shifted from communitive to researching. As previously discussed, an example of a statement supporting the development of this theme was provided by Eileen: "*We focused on much more research in this module (PBL Problem 3) than before and we did research throughout the whole*

module instead of just during the first few days or so. This would help explain an increased frequency of nonverbal researching behaviors with the onset of increased problem difficulty.

The temporal duration of nonverbal behaviors may also be a factor. Conceivably, the duration of these non-verbal behaviors is longer than verbal behaviors, which could account for the lower overall frequency counts. Duration of behaviors was not measured in this study, yet if nonverbal behaviors were taking extended time it would decrease the amount time spent in class for discussion. Also, a shift from one nonverbal behavior to another may be less obvious than a shift to a verbal behavior that has an auditory cue. For example, it was difficult for observers to visually observe and distinguish between researching and typing notes behaviors when students were using laptop computers. Therefore, it is also possible that capturing the nonverbal behavior of typing in a collaborative document or researching with electronic was under-recorded in the data collection. This would lower levels of observable engagement overall possibly creating a false impression that engagement and motivation were diminishing if one strictly uses the quantitative data for interpretation.

An alternative interpretation to explain the different engagement levels across subject presentation types could be that students were becoming more aware of the value of the nonverbal activity of research for problem solving and therefore, they increased their use of the behavior as they progressed through each of the PBL problems. The ideal balance of self-led directedness and ill-structuredness of pure PBL problems (Barrows, 1986; Hung, 2011) should trigger the need to research and answer questions raised in the PBL process. Barrows (1986) described the PBL process as cyclical, where the steps of asking questions, and researching are repetitive and evolve with gradual learning. Therefore, it would not be unusual that frequency of nonverbal behaviors would also fluctuate throughout the four problems as they engage in

different steps of the PBL process. The quantitative findings from individual nonverbal behaviors support this possibility. The frequencies of three of the individual nonverbal engagement behaviors were the highest in PBL Problem 4: researching with electronic media (197 frequency count), researching text (172 frequency count), and organizing action (134 frequency count). In PBL Problem 1, researching with electronic media was at its the lowest (78 frequency count) and successively increased with each change in subject presentation type. This pattern was also observed for the behavior of organizing action (i.e., using white board or shared document).

Researching using text also increased in each of the first three levels of subject presentation type variable suggesting a connection to level of subject presentation type, but it differed from the other behaviors by declining with the onset of PBL Problem 4. This may be attributable to the nature of the specific research necessary for the problem solution of PBL Problem 4. Content knowledge on instrumentation options was not widely available in text format necessitating an increase in the use of electronic media. The nature of this PBL problem also required students to use specific evidence in their rationale for speech and voice acoustic instrumentation recommendations for the clinic. Therefore, the nature of the problem itself may have guided students into more nonverbal research activities. Students were required to provide evidence and rationale for their other problem solution recommendations on Speech Breathing, Phonation, and Speech Acoustics. However, this content was more widely available in text resources. The specific content topic area for PBL Problem 4 was related to researching and comparing different instrumentation options and not easily found in textbooks, possibly augmenting the individual behavior of researching using electronic media. This is consistent with the goal of using ill-structured problems in PBL as previously described by Hung (2011).

Another possible influence on the shift to nonverbal engagement may be from the real subject of PBL Problem 4. The university clinic director verbalized her own thoughts and impressions on the challenges she faced regarding selecting instrumentation for serving the patients of the university clinic for speech and voice acoustic analysis. Students may have seen the problem subject as a person of authority and they may have deferred to her initial impressions as a consequence of feeling like they had less knowledge and experience than the clinic director. As a result, a lower sense of competence may have contributed to the decreasing the amount of verbal questions and more nonverbal behaviors. Students may have focused on seeking an answer they believed the problem subject was looking for rather than purely brainstorming and hypothesizing from their research and discussions. This would be analogous to how some students will try to anticipate what an instructor is "looking for" when operating in an instructor-centered learning environment where the instructor is the authority figure. It also would be consistent with the suggestion by Keegan (2017a) previously noted that some students at the undergraduate level may be operating at an absolutist stage of reasoning. It is also possible that the nature of the problem for PBL Problem 4 may have shifted some students away from the traditional PBL steps as they tried to find a specific solution and bypass the cycle of questioning and discussing. This shift away from a pure PBL characterization may lessen a student's active role in problem solving (Hung, 2011), and would represent some loss of fidelity in PBL and potentially a decline in active engagement.

The PBL problem statement did provide some specific names of instrumentation and computer applications that the clinic director had considered previously and were intended as triggers for brainstorming. However, the triggers in this case may have actually limited the discussion and fostered nonverbal research on the specific options rather than opening up the

discussion to novel instrumentation or software applications. Some groups did provide recommendations beyond the instrumentation and apps that were discussed in the problem presentation, but the majority focused primarily on the examples provided by the clinic director and those that were listed in the problem statement.

This behavior of frequent engagement in non-verbal research activities was validated by investigator observations of periods of silent, yet on task, research using the internet during PBL group meetings in PBL Problem 4. While the frequency of engagement behaviors diminished, it is possible that the nature of the engagement shifted to being more reflective and contemplative as students attempted to make the evaluative decisions that the PBL problem scenario required. One may argue that it is not necessarily a negative finding to see a shift to nonverbal engagement if it is contributing to the problem-solving activities.

Accountability, responsibility, and problem ownership foster motivation. A final aspect to consider is the possible shift in motivation pertaining to qualitative statements related to accountability. In the initial two modules, a category emerged for students' accountability to peers (i.e., being perceived as doing their fair share, impressing peers with effort) and by fulfilling assignment requirements. The perceived value of finding a problem solution that will serve the familiar setting of the university clinic for these students aligns with the immediacy and intimacy dimensions of the social presence construct (Short et al., 1976) and also the variables of problem design proposed by Hung et al. (2013) to influence psychological connections between students and the problem (i.e., location proximity, temporal proximity, personal interest, and career interest) for potentially enhancing motivation.

PBL Problem 4, the highest subject presence level (i.e., real person with a face-to-face interaction), appears to have been complemented by students being able to relate the problem

directly to a location they were personally familiar (i.e., the university clinic) and also the direct applicability to themselves or their peers as future graduate students. The university clinic setting provided location proximity and the problem solution was needed in the near future (temporal proximity) since some instrumentation was being discontinued. Hung et al.'s (2013) suggestion that location proximity and temporal proximity are valid ways to foster psychological connections between students and the problem were supported by Theme 4 from Chapter IV, direct interaction with problem subject and high solution value enhanced accountability and realism. Recurring references to the relevance of the timing and the applicability of the problem to students' current environment and their future settings as graduate clinicians working in the university clinic align with the location and temporal proximity concepts described by Hung et al. (2013). The face-to-face interaction by a familiar person in the Level 4 subject presentation type also provided authenticity and intimacy. As discussed in Hung et al. (2015), the prospect of collaboratively addressing a common goal within a meaningful activity support a connection and applicability of content to everyday life. Although PBL Problem 2 and PBL Problem 3 also used real subjects with the same location as the problem setting as in PBL Problem 4, they did not have the same temporal proximity or the urgency and authenticity that reporting to a familiar person in a face-to-face interaction seemed to provide the students.

Hung et al., (2013) suggested that students might need additional elements for motivation in PBL beyond the problem being a real situation. Their assertions appear applicable to these findings since all three of the final problems were real situations. These findings align with PBL literature from Barrows and Tamblyn (1980) that a student will have a higher level of motivation when they have self-identified what is significant and meaningful for them, thus creating internal or intrinsic motivation rather than motivation supplied from an external source. Although each of

the subject presentation types had different levels of subject presence, this assertion may provide the strongest interpretation yet why motivation was described differently by students at the end of the course (i.e., high for PBL Problem 4) and in contrast to the decline of engagement behaviors shown in the quantitative findings, which may be explained by the shift in the types of engagement behaviors as discussed previously. The students may have found the solution for PBL Problem 4 as the most significant for them personally because they found the necessity of the solution credible and it allowed them to directly help the problem subject. The interaction of several identified codes supporting Theme 4 including: subject presence, empathy, meaningfulness, authenticity, urgency, location and temporal proximity in the problem design, may have sparked motivation in a more meaningful way in the final PBL problem than for the other subject presentation levels.

The interpretation of the findings for the research question—how does the subject presentation type of problem scenario (e.g., a real person who is involved in the problem case) within a PBL problem scenario affect student motivation measured by levels of student engagement during the PBL instructional process? —is not a simple one. As discussed there were probably several elements influencing the different engagement levels observed in the quantitative findings across the subject presentation type and the variations in student perceptions of motivation. Fatigue, variations with prior knowledge and content difficulty, novelty of PBL as an instructional approach, shifting types of engagement and evolving levels of personal accountability, problem ownership, and personal responsibility were all recognized as playing a role in the study findings.

Research Question 2: **How does one's career interest, personal connection/interest, or prior experience with subject problem content area, or other additional factors affect student motivation and engagement when participating in a course using PBL?**

Qualitative themes from reflection journals and investigator field notes did provide indications that emotional and empathetic connections (i.e., psychological connections) and applicability to future work settings (i.e., authenticity) were impactful on the engagement and the learning experiences of students in this study. It had been anticipated that student motivation levels would be the highest when there is a career or personal interest. Students were able to identify a connection to their future career aspirations in each of the PBL problems, as reflected by the consistent frequency of reflective statements in journal assignments across problems. Students noted authenticity of future work settings from the problem as a facilitating element, which may also have contributed to student motivation as they could envision themselves in the setting and therefore it created interest and enjoyment. Elements related to future career diagnoses, work settings, and client types were purposely embedded in PBL problems using the 2nd generation 3C3R problem design model. Therefore, it is not particularly surprising that students were able to make those connections consistently across each problem but it does help provide validation for using the problem design model for embedding these aspects into the design of the problems.

Problem scenario applicability to future career interests or aspirations and identification of appreciated skillsets. The contribution of applicability to future career interests may have helped foster motivation because students may have realized the importance of communication as an applicable competency for their future professional aspirations (i.e., communicate problem solution). For example, PBL Problem 1 required students to explain their

findings as if they were presenting to the patient, a specific competency for a SLP professional and a student learning goal in the graduate SLP curriculum. PBL Problem 2 and PBL problem 3 required students to present considering the patient and clinical supervisor as their projected audiences, providing applicability to future roles as graduate students. The value of this aspect was expressed by Jen in her statement presented in Chapter IV from PBL Problem 2, "*I think the parts of this module where we had to put the information we found into conversations so that the patient and family could understand is a crucial skill to have,"* demonstrating her realization of the applicability to her future career aspiration. This provides another example of what Barrows and Tamblyn (1980) may have intended with their assertion that a student will have a higher level of motivation when they have self-identified what is significant and meaningful for them. Being able to effectively communicate a future skillset was motivating for Jen.

It is possible that the benefit of students realizing the connection to their future career aspirations creates both interest to engage and a reason to sustain effort by becoming an enjoyable learning experience and supported relatedness to their aspirations. Multidisciplinary collaboration and the need for communication with patients and caregivers were two categories identified by students in reflective statements for PBL Problem 1 and PBL Problem 2 related to career relatedness. It is possible that being able to identify these aspects of a SLP professional's role provided students with higher level of motivation.

Similarities with problem subject characteristics/background trigger personal interest. Students may have been better equipped to relate to the problem subject when the subject characteristics matched their own characteristics. Several students referenced the age of the college student in PBL Problem 1 as helping trigger empathy. Some students also noted the similar age and relatable profession of the subject in PBL Problem 2 (i.e., college student). It is

possible the closer the alignment between subject and learner, the more likely relatedness could be elicited. As previously noted, students discussed their connections to problems in the data supporting the development of Theme 1, personal relatedness transpired from problem and subject characteristics)**.** Sandy's statement from the findings in Chapter IV provides an example of relatedness based on her recognition of the similarities, "*Through all the (*my*) moves, foreign soccer coaches, and knowing another language myself, I am very drawn to the differences in language and the process of accumulating speech traits to your immediate environment."*. Personal curiosity, prior experiences, and subject characteristics were identified by students with regularity, providing support that these elements were of value for triggering interest in this study's PBL design.

In PBL Problem 1 the alignment between subject and learners triggering empathy and personal interest was especially pronounced. PBL Problem 1 used a fictional subject and was presented in written text from an adapted case study and was not anticipated to necessarily trigger high levels of engagement. The problem did, however, generate an interesting category and related codes from analysis of the written reflections. The assignment of empathy and emotion to: the problem subject, the patient's injury (i.e., quadriplegia), and the related elements in the problem story (i.e., therapy dog) provided signs of students creating an affective connection with the problem subject. It was the PBL problem with the second highest level of observed level of engagement behaviors (2511 frequency count) and was identified by 24% of the students as the problem providing them with the highest level of motivation in the final course reflection. The problem also, as previously noted in Chapter IV, resulted in five of the eight PBL groups spontaneously assigning a name to the unnamed fictional character to personalize the problem in their problem presentations to their peers. This finding was disparate

from the concerns raised by Kenny and Began (2004) that a fictitious paper case may guide learners to a perspective that will also reduce the personal connection or attachment to the subject, rather students were able to identify a connection when the problem subject attributes (i.e., age) was similar to their own age.

One interpretation of this finding could be that using a written text subject presentation type or a fictional character may not necessarily mean it will not be useful for triggering motivation, rather there is potential to elicit a connection through personal relatedness, as was suggested in Theme 1 from the qualitative findings, where personal relatedness transpired from problem and subject characteristics. This provides support for using a problem design model such as the 2nd generation 3C3R model to embed affective elements to create a psychological connection with the PBL problem (Hung, 2016). Some students related the situation of the fictional character to themselves based on the emotional consequence of her injury (i.e., quadriplegic) or expressed their strong personal interest in how therapy dogs can assist with communication disorders. As noted in Chapter IV, the alignment of subject characteristics with the learner characteristics, prior experiences, or personal interests provided opportunities for relatedness. There may be additional opportunities to enhance motivation even when using a fictional character as a problem subject. It may suggest learners will naturally seek relatedness even when it is not explicitly provided, providing encouragement for continuing to embed these elements in PBL problems whenever possible as a way to foster psychological connections. This design approach may reduce Kenny and Began's (2004) concern about using fictitious problem cases mentioned earlier. Additionally, it could be an argument for the importance of using design methodology that values psychological aspects of emotion and empathy, similarly to the

conceptual framework used for this study's PBL problem design, the 2nd generate 3C3R problem design model (Hung, in press).

Developing a personal connection was one argument presented by Keegan et al. (2017) in their decision to integrate problem-based learning with a civic engagement component via a service learning in their SLP PBL course, providing a direct interaction with clients with similar ages and diagnoses as those being used as part of their PBL problems. Although they did not use real subjects directly in their PBL study, the benefits they identified for their students—development of compassion, empathy, and an awareness of the applicability of the content to future career goals—are similar to positive aspects of the PBL experience described by students in this study.

Research Question 3: Does PBL provide an effective instructional method for content mastery for Speech and Voice Science learning outcomes within a Speech, Language and Hearing Sciences undergraduate course?

The interpretation of the quantitative findings related to content mastery provides one snapshot of the students' ability to demonstrate their mastery of content, yet the mixed findings did not provide a clear answer to the research question. An analysis of the success or effectiveness of the PBL method in this context can be interpreted differently depending on how one measures effectiveness. If using assessment scores, there was not a clear pattern between the assessment scores across PBL and non-PBL implementations. This makes it difficult to assert a specific relationship between PBL and learning outcomes given the numerous confounding variables related to student characteristics and assessment design. The growth for development as a learner is challenging to assess with static assessments of factual knowledge. Learning deeply is a gradual, incremental process and students were likely at varied stages during the

study with their content knowledge acquisition which may have been reflected, in the lower performance (M=78.7, SD=10.9) on the final exam that assessed factual knowledge acquisition. The analysis done by Dochy et al. (2003) on knowledge and skill related outcomes for PBL studies noted the variation in effect sizes for PBL outcomes was associated with different levels of student expertise. This may support the interpretation of students being at different levels of content knowledge acquisition.

Application versus factual knowledge. Whether or not PBL provides an advantage for both applied and factual knowledge has been discussed in the literature (Albanese & Mitchell, 1993; Dochy et al, 2003; Norman & Schmidt, 1992). The interpretation of this study's findings also raises questions. Factual knowledge provides students with foundational tools to be able to effectively engage in discussion, reasoning, and problem solving and it often is used to assess content mastery. Applied knowledge represents one's ability to connect concepts to a problem or dilemma in order to make informed and reasoned decisions. Students did score the lower on their final exam content assessment (M = 78.7, SD 10.9) for factual knowledge than they did on the final applied project (M = 94.0, SD 3.8), however, they were not assessments of the exactly the same content. In order to compare the PBL students' performance with the non-PBL students from previous years, the questions on the exam were factual knowledge assessment only. The applied project was separate from the four PBL problems and provided an opportunity for students to verbally present their interpretation of the connections between speech science domain knowledge and applied topics related to either clinical disorder or research. The quantitative findings comparing the PBL exam year with non-PBL exam years had mixed results, with one PBL/non-PBL pair showing a significantly lower score (p = .013) and one nonsignificant lower score (p = .08). The lower assessment score on the final exam in the PBL

year does align with PBL literature that suggests students' factual knowledge acquisition tends to be a weaker aspect of PBL in general (Albanese & Mitchell, 1993; Gijbels, Van De Watering, Dochy, & Van den Bossche, 2005; Norman & Schmidt, 1992; Walker & Leary, 2009).

A better assessment metric may have been to assess student performance on am additional, final PBL problem as a summative assessment of applied knowledge rather than using a comparison to factual knowledge performance. This would have allowed the assessment of applied learning rather than just factual knowledge recall. Dochy et al. (2003) described in their meta-analysis that studies have described lower initial knowledge in early years of PBL, although this is offset by longer retention of the applied knowledge. The students in SLHS 421 may be analogous to students in early years of PBL as they were in their first PBL experience. Dochy et al. (2003) also described studies where PBL students have a smaller breadth of knowledge but also greater depth of the knowledge. One may argue that the assessment measures of this study (i.e., factual knowledge) would not capture the gains Dochy et al. (2003) describe as longer-term retention of acquired knowledge. A final summative PBL problem that integrated previous PBL content knowledge from prior PBL problems may prove to be a better measure of the SLHS 421 students' abilities to retain their acquired speech science knowledge.

What may have been a benefit of the study's PBL approach, as also identified in the PBL literature, was the maturation of the students' abilities to discuss and talk about speech science concepts in everyday terminology and to reflect on whether they know the content well enough to verbalize the information to someone else (i.e., applied knowledge). Visconti (2010) had described their implementation of PBL at the undergraduate level for their communication disorders course as resulting in positive student perceptions of gains in synthesizing information and this appears similar to the findings of this study. As previously noted in Chapter IV, the

following student statement provides an example of this type of synthesis as a positive outcome in this study.

> *In previous courses, I mostly just categorized these components altogether in forming speech, but I had never individually gone through each system and identified its contribution to speech. I feel more confident in explaining the different parts of speech to someone who is unfamiliar with the process.* (Ella)

Even though synthesis was not formally measured as assessment in this research, the ability to understand fundamental scientific information explaining speech and voice and apply knowledge of scientific concepts in scenarios relevant to discipline of speech, language, and hearing sciences was an overall course instructional goal for SLHS 421. Student self-assessment may also prove to be an important way to assess mastery of the learning outcomes typically associated with PBL learning approaches (e.g., problem-solving, self-directed learning) by comparing gains over time. This was completed in part during this research, using reflection prompts related to content mastery of the course's learning objectives.

The final applied project at the conclusion of the study was designed to showcase students' abilities to apply concepts to clinical disorders and research topics. Their performance on this assessment was strong from the subjective assessment of the investigator. This may provide support for the argument that PBL is indeed effective for teaching speech and voice science domain knowledge because it allowed students to connect factual knowledge to applied knowledge. It is possible, however, that student's factual knowledge for PBL Problem 3 and PBL Problem 4 was not encoded deeply to allow recall in a summative exam format at a very high level. Yet, students were able to apply some factual knowledge to their applied projects. Although it was a more specific and narrower scope than the factual content on the final exam.

Since the final exam did not use application or scenario based questions, one is unable to specifically compare applied versus factual knowledge for the final PBL problems directly. Other factors specific to these students and the PBL design for this course may have played a role in the variations in assessment performance that were used during the study.

PBL effect of individual versus group researching. Another consideration for the lower factual knowledge performance could be another artifact of the PBL process and design. Some students identified the PBL step of assigning individual research tasks as a potentially limiting factor affecting their learning. Dividing workload may have increased efficiency in problem-solving, yet for topics where prior knowledge was low or content difficulty high, this division of workload may have actually hindered deep learning of some content if students consistently only focused on their assigned research or struggled to learn from their peers who may or may not have had a firm grasp of concepts. This possibility could represent the erosion of PBL described by Czbanowska (2012), yet it is not demonstrating low engagement, rather a different form of engagement (i.e., nonverbal researching). It may be that one needs to adapt the PBL steps to align with the actions and or needs of the students to allow the fidelity of PBL to be maintained to accommodate individual researching that began to emerge. For example, upon observing additional time spent in non-verbal researching or a division of workloads, more time may have been needed for the final PBL problem to allow students time for engaging in discussion and peer teaching. The ability to modify the duration of individual PBL modules with varying levels of content or problem difficulty or with signs of fatigue may prove to be a useful strategy when overseeing instruction in a PBL learning environment. One size fits all for the duration of PBL problems across the course allowed for equal comparison of PBL experiences for this research, but may not have provided enough adaptability to support the changing needs

of students in this study. The following section provides additional implications of findings previously presented in Chapter IV.

Additional Implications

Group dynamic supporting PBL process. The PBL literature showed group dynamics as an important factor in influencing student learning (Barrows, 1986; Savery, 2006; Whitehill, et al., 2014). The data in this study supported the role and importance of group dynamics for having a positive learning experience as demonstrated with Theme 5, where group dynamics and PBL supports (i.e., assigned roles, learning artifacts) fostered a positive learning experience. Elements of stress and frustration were identified early in the course with the unfamiliarity of PBL as a learning approach and also with increased content difficulty over time, however, this may have been mitigated or perhaps lessened by the enjoyment stemming from positive group dynamics. The category of positive group dynamics emerged in PBL Problem 1 and continued to be present in final course reflections. For example, as previously noted in Jan's statement in Chapter IV, "*In regard to module one, the team really helped me pull the content together and understand it in a new and different ways.",* the group's role served an important function contributing to the student experience. By the start of PBL Problem 2 students had been working together in groups for four weeks (i.e., practice problem and PBL Problem 1) and the positive influence of the group dynamic started to appear in journal reflections. Students who felt comfortable with their peers, or enjoyed the interaction and dynamic with their groups and facilitator, may have been more likely to benefit from learning from their peers and felt comfortable asking questions or initiating discussion that is central to the problem-solving process. It is also possible that positive group dynamics will allow students to be more motivated overall and for longer periods of time.

It may be worthwhile to consider when and if group composition should be modified during the PBL process. Students were provided with an opportunity to change groups after the practice module and before the start of the study, but it was not considered for discussion again to maintain the integrity of the research design. Students were assigned initially to the practice groups randomly per the methodology design of this study. In the first course section 96% (22/23) students and in the second section 78% (18/23) students voted to maintain their current groups. This provides some indication that students were pleased with their group dynamic at the start of the study. It is possible this element of choice that was provided to the students before the onset of the data collection may have been beneficial to the group dynamic, which would align with there being a sense of autonomy as described in SDT (Ryan and Deci, 2000a) for facilitating motivation. In the final reflections some students did note, however, that in retrospect they believed changing the group composition would have been a positive change. Personal interest and enjoyment are associated with motivation (Ryan & Deci (2000a); therefore, it is reasonable that the findings of positive group dynamics for these students would have been facilitative for the PBL learning process and motivation.

Supportive Effects of Artifacts in Learning Process. The idea that learning is fostered in PBL when "people create and re-create knowledge together," Barrett and Moore, (2011, p. 115) provides a rationale for the impact of using a shared group collaborative assignment within the PBL course design (i.e., learning artifact). Students were required to submit a "learning artifact" with each PBL problem to demonstrate their ability to organize factual knowledge and their problem recommendations. These learning artifacts were intended to provide a shared point of discussion during PBL problems, document progress toward learning goals and objectives for each problem, and also be used as a form of assessment. It also may have been a source of

autonomy that Ryan and Deci (2000a) describe as a necessary component for intrinsic motivation. Students were encouraged to try different variations and were afforded autonomy to select from a variety of acceptable options, which included: narrative journals, graphic organizers, shared documents, posters, or other electronic presentation media. *S*tudents frequently commented on how the learning artifact was supporting their learning and collaboration. The development of shared learning artifacts appeared to foster shared attention during group meetings.

Implications for Speech Language Pathology Curriculum and PBL Problem Design.

There are several aspects of this study's findings that may have implications for either the PBL design process or for continuing the expansion of PBL within SLP. This study provided an example of how social presence could be integrated into PBL problem design. Given the generally positive perceptions from students of this study for using a real subject who was involved in the problem, there does appear to be merit for continuing to incorporate and study the impact of social presence to optimize psychological connections. The immediacy and intimacy dimensions of social presence (Short et al., 1976) were used to develop the variations in subject presentation type for this research. It also could be used to design variations in problem setting or content topic areas, especially if one is aware of the future work settings or necessary professional skillsets for a professional discipline using PBL. For using PBL in SLP, this could mean framing problems around a familiar setting (e.g., university clinics, internship placements), a frequent communication disorder, or engaging with faculty or practicing SLPs to identify problem areas where recommendations from students using PBL, could contribute to a solution.

Instructors and problem designers could also benefit from systematically discussing or eliciting written feedback from the learners using PBL regarding the problem aspects that they

deem as important and meaningful. This could mean creating a space within the PBL course to debrief on a more regular basis, or expand the facilitator/tutor role to consistently probe how learners are responding to the problem design elements. Reflection from students on their learning outcomes is already an important aspect of PBL. Student perceptions of the problem characteristics or their insight for motivation may be more beneficial to students and the instructor if feedback was formative and frequent rather than only at the end of the PBL experience as a part of a summative final reflection.

Many students in this study were successful in identifying several psychological elements (e.g., emotion, personal interest) that were embedded using the 2nd generation 3C3R problem design framework, and they identified authenticity elements in both fictional and real subjects. Students appeared to perceive the final problem as particularly authentic describing it as "*the most real-life one yet*" (Kelly), which is interesting and appropriate since it was indeed an authentic, yet it highlights how perception of authenticity can vary from the perspective of the learner or be influenced by how it is presented to the students. This helps validate using a systematic problem design framework to construct PBL problems to help guide the instructor through problem design process. As demonstrated in this study, there are confounding and intervening variables surrounding the use of PBL problems that may be difficult to anticipate. This may depend on several factors including: the maturation of the learner, group dynamics, and experience with PBL. Ideally, it would be beneficial to anticipate whenever possible the problem characteristics that will likely have the most emotional features, personal relevance, or authenticity for students preparing to be SLPs. To identify these factors, it may indicate the importance of considering the interests and learning environment of the learners more carefully in the PBL design process. Or it may indicate the importance of reflecting on the assumptions

that were made during the design process by eliciting regular feedback on problem design from the learners. This could help create a more robust body of research on problem design specific to the SLP discipline using PBL. Additionally, piloting PBL problems with different groups (i.e., clinical supervisors, faculty, students) in a SLP program during the design process may be another way to introduce PBL to faculty or students who may be wary about using a learning approach that is likely much different than their own prior experiences.

Problem difficulty challenged some students and overwhelmed others. An awareness of this dichotomy has implications for PBL, as it is important for instructors to be perceptive to whether or not students are being overwhelmed by problem complexity. A negative experience could lead to poor engagement with peers, content, or the facilitator; it also could lead to dissatisfaction with the PBL process. The other possibility is students will be challenged at a level that is just beyond their capabilities, as is described by Vygotsky's zone of proximal development (Driscoll, 2005) creating an optimal space for new knowledge acquisition. Creating a balance of problem difficulty to challenge, yet not overwhelm students, with the appropriate amount of scaffolding is an important consideration for PBL design (Hung, 2017).

Since SLP undergraduate programs usually are affiliated with graduate training programs for SLPs and typically have on-campus clinic components, there is the potential for a wide variety of PBL problems to be developed using real subjects and clinical scenarios from clinics with close location and temporal proximity aspects identified by Hung et al., 2013. Identifying the ways that the problem solution could be communicated directly to an involved person in the problem appears to be an appropriate design consideration for instructors using PBL in SLP to consider whenever it is feasible and appropriate. Whether or not the problem solution will be used by someone, provide an immediate impact, or be actually implemented is another important

implication worthy of consideration during problem design. It appeared to create interest and ownership for the students in this study and it would be worthwhile to continue to explore this in future research. The subject in the final problem of this study was not an actual clinic patient, yet this problem supported engagement among students despite using a related character (the university clinic director) rather than an actual patient in the problem. Clinical faculty supervisors or potential graduate students could also serve as problem subjects in face-to-face interactions. This may help alleviate logistical issues (i.e., cost, privacy) with using real patients or with using standardized patients (Yoon et al., 2016) while maintaining the value and authenticity of having a real person involved in the PBL problem case to trigger a personal connection. Implementing this type of PBL format using undergraduate clinical disorder cases may provide a way for students to develop a connection with their future university clinical settings, possibly making the transition to graduate clinic experiences less daunting.

One may argue that asking about the effectiveness of PBL for content mastery should actually be supplemented with another question. For example, does PBL within SLP provide the learner with the tools that will support growth in content knowledge at a level that is necessary to apply knowledge in the context where that knowledge is used in their future professional roles. As a result, it may have implications for how we design our assessments and learning activities. This course used reflective journals, student self-assessments, online content quizzes, an applied project and a final exam to assess content mastery. How we assess effectiveness may possibly be better served by using other dynamic assessment methods than traditional summative assessments on domain content. Dynamic assessment in SLP refers to assessments that use mediated learning experiences to identify the aspect of the assessment that is problematic and determine what teaching strategies are facilitative as a way to identify the best practice for

intervention strategies (ASHA, 2017e). Adapting assessment methods to the specific performance of the patient using dynamic assessment is an issue advocated by ASHA for SLP professionals. SLPs use different dynamic assessment strategies when they are providing assessment for patients with communication disorders; therefore, it may be appropriate to model this type of assessment philosophy in undergraduate SLP curriculum so students could experience it in their own learning before they use it as a professional for assessing children and adults with communication disorders.

A final implication relates to a potential weakness from this PBL design pertaining to depth and breadth of content mastery. Some students identified they had less content depth when they relied on their peers for research. This and future PBL courses could possibly benefit from additional formative assessments for factual knowledge within the course implementation (Hung, 2014). This may serve to reinforce factual knowledge and also create as a mechanism for the facilitator to understand if there are gaps developing in knowledge acquisition during the PBL process rather than at the end of the course. This is especially important if the PBL design uses overlapping content knowledge across problems. For example, knowing in hindsight the difficulty with PBL Problem 3 content, it would have been appropriate to advise students to address some of the more difficult content simultaneously rather than as divided research tasks. It also may have been useful for the facilitator/tutor to provide more emotional support for students who were struggling with the challenge of difficult domain concepts. Thus, it may have provided an improved level of support for them in their ability to cognitively engage with the content and their peers during the PBL experience.

Limitations

One key limitation of this study's findings is the extent to which generalizations may be made pertaining to the observed engagement levels. Direct observation of engagement was intended to provide a more objective measure of engagement than subjective observations or student self-ratings alone would provide, however, real-time observations are subject to human error when there recorded observation are not used to verify data collection. For example, individual nonverbal engagement behaviors are less visible and require visual observation rather than just an auditory observation of a verbal engagement behavior, it is possible the reliability of the nonverbal engagement behavior may be questionable or underreported or that the verbal engagement frequency did not capture the quality of the engagement. The observational rubric required observers to identify both verbal and nonverbal measures simultaneously and it is possible the large number of observable behaviors on the instrument may have resulted in an underreporting of some behaviors in the real-time data collection environment as observers shifted their visual attention to document and record behaviors. The observational rubric also provided frequency counts, but it may not adequately have reflected the quality of the verbal engagement behaviors that were recorded. In addition, more in-depth engagement behaviors such as researching could also be done outside of the classroom, which could not be captured by the classroom observation.

This study used real-time observation by sampling observation behaviors using 15-minute intervals to provide a rotating snapshot of engagement in every class period. The data did not represent 100% of observable engagement behaviors for all of the groups and sampling bias could be present. The quality of interactions may have varied within groups from one observation to the next related to confounding variables that could not be controlled (e.g., student

fatigue, affect). The ratio of one classroom observer for a group of five to six students also may be a limitation of data collection, depending on the frequency and rate of engagement behaviors occurring in changing group dynamic levels.

The differences among teams related to personality differences and/or group dynamics may have affected levels of engagement and/or the nature of engagement behaviors over the course of this study. Positive interpersonal relationships with the groups were identified as a facilitating factor. However, it is possible that differences in team dynamics could be confounding variable. This study did not compare or attempt to control for group dynamics, therefore it may be a limitation of this research.

Another potential limitation for this study pertains to observer bias. Although the classroom observers were blind to the study's purpose and the research hypotheses to improve trustworthiness and validity of findings, they may have developed their own hypotheses creating introducing some bias as they recorded data. In addition, the study students were also blind to the study's purpose and research hypotheses. However, they were aware this course was the context of the investigator's dissertation research through the study's informed consent statement. Therefore, their levels of engagement or willingness to embrace PBL as an instructional method may have been influenced by empathy toward the investigator creating bias in their reflective statements pertaining to their impressions with PBL and or their engagement levels. Students were also aware they were being observed. Therefore, there was the potential for student behaviors to have been influenced from knowing their behaviors were being monitored. Journal assignments were a graded assignment and it is possible that could have created bias toward students providing overly positive reflections of their PBL experience and their levels of engagement.

The study was not a true experimental design as all students received the same conditions of the subject presentation type variable and did not compare a randomly assigned participants with a control group, so causality between variables cannot be asserted. The context of the Speech and Voice Science course for this PBL implementation represents a specific domain area and therefore, although the findings provide an example of how the variable of subject presentation type affected engagement for the students, it is not appropriate to generalize the findings to other SLP courses or other PBL implementations beyond the speculations considered in this chapter.

Future Directions for Research

An opportunity exists to continue to build on the findings from this dissertation research using future PBL implementations in SLP at the undergraduate level in several areas. A future research agenda using both the setting of this study and future courses would provide additional impetus for PBL in SLP at the undergraduate and graduate levels. First, in the PBL problems used in this study, the domain content knowledge and content difficulty varied as the subject presentation type changed. This made it challenging to fully understand how each of these aspects of PBL problem design impacted students' motivation. Future studies could continue to study the effect of subject presence using the face-to-face interaction, which was identified as a meaningful and motivating experience by many students. For example, repeating this study with problems with balanced difficulty and structuredness may help identify the relationship between subject presence and PBL fatigue at a deeper level by removing intervening variables.

Understanding the right combination of ill-structuredness and content difficulty is important. We need problems that will challenge students, spark their curiosity, and allow them to grow as learners while striving to avoid feelings of being overwhelmed. This was a finding in

the research that may have contributed to PBL fatigue. The impact of overlapping prior knowledge was also a related aspect identified in this study with potential for offsetting fatigue or frustration with challenging PBL problems. A future study replicating this research design for Speech and Voice Science could redesign the PBL Problem 3 used in this PBL design. Additional problems or modified duration could spread out and overlap the domain knowledge over a longer period of time. This may improve our understanding of whether or not overlapping prior knowledge across PBL problems would be helpful in decreasing stress or improving motivation when PBL problems are novel or difficult.

This study used students with no prior experience with PBL. An opportunity exists to continue this line of research for these students and future students creating a longitudinal research design for exploring the impact of PBL on learning outcomes with increasing levels of PBL experience. This may help isolate the novelty effect that possibly developed in this study. Implementation of additional and repeated PBL courses within the settings of undergraduate or graduate courses would allow one to compare the experience of students who do not have experience with PBL with those who do have experience. Some of the students from this study plan to continue on to graduate school creating an opportunity to follow their perspectives on PBL over time. This would allow one to explore how the PBL experience from this study has influenced their approaches to learning or problem-solving abilities within the SLP context. Insight from students who have had this PBL experience as undergraduates may help build momentum and a rationale for its expansion in the curriculum of domestic SLP training programs.

Positive group dynamics were another interesting finding with potential for additional study. Future PBL implementations could study the impact of stable versus varied group

composition or the effect of using strategies to facilitate group dynamics on student perceptions on the PBL process, learning outcomes, or motivation. This study's research design used stable groups. However, it would be interesting to explore if engagement levels can be modified with variations in group size or composition.

The literature surveyed from international PBL SLP implementations typically described PBL as using a structured time frame or fixed PBL schedule when used as part of a SLP graduate curriculum (Whitehill et al., 2013). This structure does not address the potential need for adapting the PBL structure to adjust to learner needs when content is difficult or PBL structure is overwhelming, a possibility discussed in this study. The PBL fatigue observed in this study may be related to variables of PBL module duration or levels of cognitive and/or emotional support provided by the facilitator. Although this study used a pure PBL approach instead of a hybrid model, a potential future aspect of research could compare the PBL problems from this study with variations of instructor provided content (i.e., before, during, or not at all) during the PBL process or consider variations of the amount of a facilitator support on learn outcomes, motivation, or PBL satisfaction.

Since effectiveness of content mastery continues to be debated in PBL literature and could be used as a reason some SLP instructors are hesitant to adopt PBL with undergraduate students, additional research in the area of assessment for factual and problem-solving skills would be beneficial. An important benefit of PBL is the development of problem-solving abilities and therefore, improving how we assess and provide evidence of problem-solving (and content) mastery would be useful. The learning artifacts implemented in this course design could be an area of future research to explore whether they provide an alternative and valid mechanism for assessment. In this study, student reflection journals provided a space for

students to engage in reflection during and after the PBL experience but they also could be used to explore maturation of problem solving or an alternative assessment tool for content mastery.

Finally, this research provided some validation for using the 2nd generation 3C3R problem design model (Hung, in press) to foster psychological connections (i.e., emotion, empathy) in this study's problem design. It also added support for the value of using a face-to-face interaction in PBL for its role in enhancing relatedness and encouraging student motivation. This appeared to be enhanced by the immediacy of the problem setting being close to the students' experiences. Future research could expand on this finding by exploring the effect of immediacy in more depth using problems with different levels of location and temporal proximity. This study identified students making emotional connections to both fictional characters and real subjects because of similar personal characteristics, related personal experiences, and personal interests. Continued research in this area and the others previously discussed will help build a body of evidence for PBL problems specific to SLP curricula and PBL problem design in general.

Conclusions

The main purpose of this study was to understand how variations in the presentation modality of a PBL problem scenario subject (i.e., subject presentation type) could impact motivation for student engagement. The study used a course designed for problem-based learning (PBL) within the context of Speech and Voice Science curricula at the undergraduate educational level. A gradual decline in total engagement behaviors was observed over the implementation of four different levels of subject presentation type—primarily in verbal engagement—as the PBL process unfolded in this Speech and Voice Science course. This decline aligns with concerns in the literature for PBL fatigue, however, it also identified how the

nature of engagement may qualitatively change and shift between individual verbal and nonverbal behaviors as the problem difficulty level and the subject presence level changed. Students shifted their engagement to include more nonverbal engagement activities (i.e., researching, organizing) in the final problems where the problem was less structured and the subject presence level provided the highest degree of social presence.

Although total engagement declined and fatigue appeared to play a role, most students identified the problems with high social presence (i.e., audio-visual, face-to-face interaction) as motivating despite a lower frequency of observed engagement behaviors. Engagement was the highest for the initial two PBL problems using a low subject presence (i.e., text) possibly because of a novelty effect of using PBL for the first time or perhaps because the problem design embedded subject characteristics that fostered psychological connections and relatedness to the problem subject.

The study also provided examples of students describing their motivation for engagement from a combination of extrinsic and intrinsic origins. These included: personal accountability to peers, personal interests, prior experiences, career aspirations, empathy, and emotion, challenging content. They also included a sense of ownership for solving a problem students perceived as having importance, value, and immediate utility. The problem using a real subject in a face-to-face interaction for the subject presentation variable emerged as having some positive advantages for fostering student interest and relatedness. Students expressed they were able to develop a sense of ownership and responsibility for their problem-solving efforts that was fostered by the direct interaction with the problem subject and their familiarity of the problem setting (i.e., university clinic).

This dissertation research provides encouragement for researchers wishing to explore PBL as an instructional method within Speech Language Pathology at the undergraduate level. The majority of students were able to positively embrace and adapt to using a PBL format for Speech and Voice science, despite it being an unfamiliar learning approach. Students were able to describe their mastery of learning outcomes for Speech and Voice Science content. Finally, this study demonstrated the value of embedding student reflection in the learning process. Reflection is encouraged as a key part of the problem-solving cycle, and student reflections demonstrated that students were able to self-identify their personal growth as learners and gain content knowledge. Both are intended benefits for using a PBL instructional design. Despite some initial concerns and apprehension about the PBL structure and process, the majority of students expressed enthusiasm for their first PBL experience. Ideally this learning experience will be the first of many future PBL opportunities for these students, allowing them to continue to make meaningful connections using real patient stories and authentic problems.

APPENDIX A

SLHS 421 Syllabus at a Glance: Speech and Voice Science

Minnesota State University Moorhead

421 Speech and Voice Science (3 credits) - Course Syllabus Spring 2017
Mondays & Wednesday 1:30 PM – 2:45
225 Murray Hall

MSUM BULLETIN COURSE DESCRIPTION
The study of speech acoustics and physiology, incorporating both voice and articulatory aspects of speech signal production, as well as the instrumentation needed for measurement of speech acoustic signals.
Prerequisites:
SLHS 202 - Anatomy and Physiology of Normal Speech and Hearing AND
SLHS 201 - Linguistic Phonetics

COURSE & INSTRUCTOR INFORMATION: **Instructor – Elaine Pyle, M.S./CCC-SLP**
Email: pyleel@mnstate.edu Checked daily M-F & Sunday evening
Phone #: 218-477-2393 – (Monday – Friday)
Office: 223A Murray
Office Hours: Posted weekly on door – May vary with clinic schedule' office hours also by appointment (call or email to schedule) Typical schedule; MWF 11-12; Mondays 1-4; TTH 2-4

Graduate Assistant: (Name) Email: My graduate assistant will assist with PBL group facilitation and also have access to Desire to Learn/Brightspace for the purpose of recording points and managing content for related class activities.

COURSE FORMAT
This course will use a Problem-Based Learning (PBL) instructional design, which allows us to connect concepts to authentic situations requiring one to actively engage in the collection and analysis information via engagement with our peers and course facilitators. Our in-class meetings will consist of **group meetings, learning activities, and group discussions. Individual and group participation will be required both in-class and outside of class**. As a senior undergraduate course, it is expected you will integrate content and knowledge from several content areas within the Speech, Language, and Hearing Sciences major. This course is intended to provide you with a general understanding of the scientific principles and concepts which explain voice and speech production, provide you with knowledge of instrumentation clinical professionals and researchers use in the field of speech- language pathology and audiology, and increase your awareness of the relevance and connection of speech science concepts within research and clinical practice for communication disorders. In addition, the PBL format of this course is purposely intended to provide a structure for developing your inquiry skills, self-directed learning abilities, and increasing your comfort with collaboration; all essential qualities for success in graduate school and in the workforce.

REQUIRED TEXTBOOK
Ferrand, Carole T. (2014). Speech Science: An Integrated Approach to Theory and Clinical Practice (3rd Edition). Boston: Pearson Education, Inc.

MY TEACHING PHILOSPHY: My goal is for everyone to learn to their maximum potential and my role is to support you in the instructional process as a resource, facilitator, and fellow

learner. My expectation is we (instructor and student) engage in a shared process when we engage in learning activities, which is optimized when we collaborate with respect for each other, encourage each other, actively engage in activities, and take responsibility for our roles. Learning is a gradual process and it takes sustained effort to move from our ability to recall rote facts to our ability to apply knowledge for purposeful actions and meaning. Learning and developing meaning occurs via varied experiences, applying new knowledge to what we already know through thoughtful reflection, and integrating personal learning preferences. These are aspects of a constructivism philosophy of learning, which guide my approach to teaching and the design of this course. Please take advantage of office hours and class time to discuss your learning, progress, or ways I can support your learning needs throughout our course.

University Learning Platform:
Desire to Learn Brightspace (D2L) will be used as our class management platform. Regular access to internet will facilitate communication. Email will be directed to your mnstate.edu address for urgent communication, otherwise class announcements will be posted on D2L under "Announcements". You can access D2L through MSUM's home page: http://www.mnstate.edu. Please check regularly for updates (at least two times a week). It is suggested that you subscribe to updates in your D2L settings and use the calendar in D2L. You can access D2L through MSUM's home page: http://www.mnstate.edu.

IF YOU NEED HELP: For help with your StarID: StarID Self Service. To learn more about D2L Brightspace Tutorials for Students; For other IT related issues contact MSUM IT Support Phone: 218- 477-2603 Email: support@mnstate.edu; Location: Livingston Lord Library Room 122

COURSE STUDENT LEARNING OUTCOMES
Instructional Goal: SLHS 421 students will **understand** fundamental scientific information explaining speech and voice, and **apply** knowledge of scientific concepts, anatomical and physiological bases for speech, voice, and hearing in solving real life problems and scenarios relevant to discipline of speech, language, and hearing sciences.

The following objectives outline specific learning outcomes to allow student to achieve our course instructional goal. Students will be expected to learn/do the following:

1. **Domain Knowledge Objectives:**
   - ***1.1.*** Determine basic physical and physiological processes in respiration and speech respiratory role in speech/voice production and vocal loudness control.
   - ***1.2.*** Determine basic physical principles of physical sciences and acoustics as it pertains to voice & articulatory productions (ASHA Standard IV A B)
   - ***1.3.*** Determine basic physical and physiological processes in phonation, fundamental frequency control, vocal registers, and vocal fold adduction/abduction ASHA Standard IV A B)
   - ***1.4.*** Explain concepts of speech acoustics and theories of speech production (e.g., source filter theory).
   - ***1.5.*** Explain the general nature of resonance, nature of resonance to system natural frequencies.

1.6. Categorize acoustic features for speech sounds and predict the articulatory postures associated with acoustic output.

1.7. Compare acoustic changes as a result of vocal and articulatory differences/pathological etiologies (ASHA Standard IV B, C)

1.8. Demonstrate use of instrumentation for analysis of acoustic samples of voice/speech, (simple and acoustic vibrations in waveform, spectra and spectrograms), loudness, and nasalance.

1.9. Differentiate between roles of articulation, respiration, phonation and resonation in speech production

1.10. Understand dynamic relationship between physiology and acoustics for voice and speech production (ASHA Standard IV A B C)

2. ***Problem solving skills objectives***
   - ***2.1.*** Identify and gather necessary information with moderate to maximum support
   - ***2.2.*** Conduct simple hypothesis generation with moderate to maximum support
   - ***2.3.*** Select most viable solution and alternative solutions, evaluate solutions and make decisions with moderate to maximum support
3. ***Self-directed learning skills objectives***
   - ***3.1.*** Generate learning issues and evaluate need for additional research with moderate support.
   - ***3.2.*** Reflect on learning process with minimum support.

ASHA standards: Areas where the student learning objectives align with 2014 Standards for the Certificate of Clinical Competence designated by the American Speech Language Association (ASHA) have been indicated. Please retain your syllabus if you plan to attend graduate school in the future for evidence of the student learning outcomes addressed in this course. See http://www.asha.org/Certification/2014-Speech-Language-Pathology-Certification-Standards/

COURSE REQUIREMENTS AND ASSIGNMENT DESCRIPTIONS

Problem Based Learning Modules (60% of grade)

In a PBL format – we are all working together (students and instructor) to construct meaning for the content areas of this course. I consider us all partners in this process and it requires us all to appreciate that we all bring unique perspectives, varied interpretations of information, and relevant questions. Respect for your peers' ideas, time, and learning style will be necessary throughout the process.

There will be four problem based learning (PBL) modules assigned throughout the course, using problem scenarios to provide an authentic problem or situation requiring application of speech science concepts. Additional instruction on PBL as a learning method will be provided before we begin the modules, however, essential elements to understand are that you will be working collaboratively as in assigned groups (4-6 members) throughout the course to research content to develop a response to problem scenarios, develop your own self-directed learning abilities, and fulfill course learning goals and objectives. Most class periods will be devoted to group meetings and periodic participation in learning activities. You will also need to meet outside of class (either face to face or online) as determined by your group. My graduate assistant and myself will rotate meeting with groups each class period. As a facilitator during this process, my role includes providing feedback on your planned learning activities, clarifying questions, and raising questions when necessary to optimize your reasoning, decision making, and content understanding. At the end of each module, groups will share their findings with the class and if applicable, to relevant individuals related to the problem scenario.

Each PBL module is worth 150 points (15% of your overall grade) and specific tasks within module assignments and point values are described below.

Group Learning Artifact – 30 pts

Using relevant terminology and concepts for the PBL module, each group will generate a concept map or other graphic organizer tool it illustrates relationships of key concepts or terminology.

Group Problem Response/Solution – 30 pts

During the last class period of a PBL module, each group will present their recommendations to the class (and in some modules to relevant individuals from the faculty or community) in a brief oral presentation, which includes a visual component (graphic display) and written outline of recommendations/rationale, followed by a discussion with peers and stakeholders for the scenario.

Individual Domain Knowledge Assessment - 30 pts

Students are expected to complete an online assessment to demonstrate their mastery of domain content knowledge applicable to course learning objectives.

Learning Journal Reflection Assignment (Individual) – 30 pts

At the end of each module, students will submit a written one-page paper reflecting on their learning experience during the module. Indicate concepts, which have been clarified during the module and what aspects of problem or activities facilitated your learning and motivation.

Peer & Self-rating of Group Participation – 30 pt.
At the end of each module, students will complete peer rating form, averages of self and peer ratings will determine your points.

Applied Project (20% of grade) – Due last week of class
Complete one of the following options. Selection of an option must be made by the first week following spring break.

Option 1: Create a tutorial or teaching explanation for a speech science concept **or** demonstrate relevant piece of instrumentation or software from one of your PBL modules or related emerging research in the discipline of speech science. Create a product that would be appropriate for a peer who has not taken SLHS 421 to understand. You are encouraged to use digital media tools creatively for presenting your instructional content, which could be in the form of a video, digital media tools (e.g., Explain everything, Jing narrated presentation) or as a live presentation to the class. Presentation should be 5-7 minutes long.

Option 2: Article reviews: Complete an article reviews of peer-reviewed research articles related to research from PBL modules **or** related to a current topic or issue in the news related to speech science. Your article review should be submitted in the form of an annotated outline and include: Introduction (summary of purpose of research); Data collection methods; results; discussion/critique of article and a statement of what you learned from the article. You are encouraged to use digital media tools creatively for presenting a brief summary of one of your articles and your critique, which could be in the form of form of a video, digital media tools or as a live presentation to the class. Presentation should be 5-7 minutes long.

Participation (10%)
Active participation with your group is very important in PBL course. This grade will be based on instructor observations throughout the semester, peer feedback on your level of active engagement in group meetings, regular attendance, and timely submission of your individual assessments and reflection papers. Please discuss with me if you have concerns about your ability to engage and collaborate with peers effectively.

Final Course Reflection Paper (10%) – Due last day of class
A final reflection paper (two-three pages) is required and due the last regular class period before the final exam meeting. Review your previous learning journal reflection assignments and discuss how your understanding of speech science concepts has evolved by responding to the provided statements/questions.

GRADING
Grades will be assigned based on points earned using the following breakdown:
PROBLEM BASED LEARNING MODULES* (600 points - 60% of grade)
FINAL APPLIED PROJECT (200 points - 20% of grade)
PARTICIPATION (100 points - 10% of grade)
REFLECTION ASSIGNMENT (100 points - 10% of grade)
Total1000 points

EVALUATION STANDARDS Grades will be based on the total distribution of points earned for all requirements.

Letter Grade	Points	General Description
A+ 100-99%	990-1000	Exceptional to Excellent range: In general, work is of a level and quality that is at highest level for grading rubric; products are in-depth, obvious evidence of deep understanding of content; work is organized and clear; includes unique or creative idea or presentation; minimal to zero errors in writing mechanics.
A 98-94%	940-989	
A 93-90%	900-939	
B+ 89-88%	880-899	Very Good to Good; In general, work is complete and meets acceptable expectations for grading rubric. Work represents solid or in some cases emerging understanding of content; limited errors in writing mechanics
B 87-84%;	840-879	
B- 83-80%	800-839	
C+ 79-78%;	780-799	Acceptable to Marginal: In general, work is partially complete or late, meets emerging level for grading rubrics; work represents inconsistent or superficial understanding of content; several errors in writing mechanics
C 77-74%	740-779	
C- 73-70%	700-739	
D 69-60%;	600-699	Minimal; Work is incomplete, meets below expectations level for grading rubric; work represents very limited or erroneous understanding of content; excessive errors in writing conventions
F 59% and below	<600	Poor: Assignments are missing, incomplete or late without permission; demonstrate lack of effort and poor understanding of concepts

***Specific assignment rubrics will be posted on D2L. The *first* PBL Module assignments will be graded providing you with formative feedback only (i.e., feedback to improve learning and quality of work); <u>full points</u> will be awarded if students engage fully in module.**

COURSE POLICIES

POLICIES AND EXPECTATIONS FOR STUDENTS

ATTENDANCE AND PARTICIPATION A high level of participation in every class and each group meeting is essential for optimal learning in a problem-based learning format class. You will benefit from your own and your classmates' engagement. As a group, you will assign each other reading and specific preparations that should be completed by next class. This course requires initiative in completing suggested readings and looking for related information. it is essential that you read, research, and discuss as we go along in the course. Students are expected and encouraged to attend all classes; however, ultimately attendance your decision and you should communicate directly with your group members about how you can remain involved and up to date, if an absence is not avoidable. See also Student Absence Policy in the MSUM student handbook: http://www.mnstate.edu/acadaff/Departments/policies/studentabsence.htm

ACADEMIC HONESTY Students are encouraged to collaborate in the learning process but at the same time, students must be honest in their coursework. It is the SLHS department's policy that every student in an SLHS course sign a statement verifying that they are the person completing the work for the course (see statement below). In this course, you can complete this online in a survey on D2L. This needs to be completed in the first week of class. Grades will not be posted until it is completed.

By answering YES and by typing in your name, you are agreeing to the following statement: As a student of MSUM and the SLHS department, I verify that I am the student completing work for this course on D2L. I also pledge that I am adhering to MSUM's Academic Honesty policy (http://web.mnstate.edu/sthandbook/policiesprocedures/academichonesty.cfm) in all of my coursework (online and in class).

LATE WORK PBL Individual assignments are due within 72 hours of the date of group reports; Work submitted beyond agreed deadlines will be graded with a 30% penalty for each day late.

ACCOMODATIONS Students with disabilities who believe they may need an accommodation in this class are encouraged to contact Greg Toutges, Director of Disability Services at 477-4318 (Voice) or 1- 800-627-3529 (MRS/TTY), Flora Frick 154 as soon as possible to ensure that accommodations are implemented in a timely fashion. Information regarding Disability Services is available at http://web.mnstate.edu/disability/ or by visiting their office at:

Disability Resource Center
Phone: 218.477.4318 | MRS/TTY: 800-627-3529 Fax: 218.477.2420 Location: FR 154 Email: **toutges@mnstate.edu** In addition, many accessibility and support topics are available by looking under the "Resources" tab in D2L or by visiting http://www.mnstate.edu/instructional-technology/accessibility.aspx

DISRUPTION OF UNIVERSITY OPERATIONS POLICY Students will face potential disciplinary action if they interfere with the cited activities. Interference is defined as "Unreasonably interfering, obstructing, or preventing the regular and essential operation of the University, which includes but is not limited to: studying, teaching, research, programs, services,

and the administration of fire, police or emergency services

TUTORING The Academic Support Center (ASC) provides tutoring for many classes through the Academic Assistant Program (AAP). Stop by the ASC located in Flora-Frick Hall 154 to complete a tutor request form. Tutors are assigned on a first come first serve basis.

WEATHER OR EMERGENCIES When the University is open, class will meet unless otherwise notified via email/D2L. However, your ultimate safety is the first priority. Please use your own discretion in making decisions in severe weather or emergencies.

FINAL EXAMINATION PERIOD **** All courses must meet during designated final exam period, per university policy. Please do not schedule vacations and/or work for this class period. We will complete a class discussion activity and finish course and peer evaluations. Failure to attend will result in a 25% deduction of your course participation grade ****

SLHS 421 Tentative* Schedule Spring 2017
Schedule subject to change as needed to accommodate content or unforeseen circumstances

Week	Session 1	Session 2
1Intro to Speech Science & PBL	Course Overview	PBL Practice Activities
2 – Acoustics Review	NO CLASS - Holiday	Library Session - Accessing and evaluating sources
3 – Practice PBL Module	Group Meeting	Group Meeting
4 - Practice PBL Module	Group Meeting	Group Meeting
5 Start PBL Module 1*	Group Meeting	Group Meeting
6-	Group Meeting	**Group Reports**
7 Start PBL Module 2*	Group Meeting	Group Meeting
8	Group Meeting	**Group Reports**
9 – SPRING BREAK		
9 - Start PBL Module 3* Speech Acoustics	Group Meeting	Group Meeting
10	Group Meeting	**Group Reports**
11 - Start PBL Module 4* Instrumentation	Group Meeting	Group Meeting
12	Group Meeting	**Group Reports**
13 - Special Topics	Voice Synthesis/Vocal ID	Cleft Palate & Resonance
14 – Special Topics	Electro larynx/Laryngeal Alternatives	Speech Perception Theories
15 Applied Projects	Work Period	Work Period
16 – Applied Projects DUE	Share applied projects	Share applied projects & Final Content Assessment
17	Final Reflection DUE	

*See PBL Guides for problem scenario description; suggested readings, and group tasks.

Appendix A

SLHS 421 Problem Based Learning (PBL) Module I

Spring 2017

The following learning objectives relate to this module in general. As a group you will also create 3-4 specific learning objectives for this specific module, which you as a group identify as essential to creating response to this problem.

- Describe basic physical and physiological processes in respiration and speech respiratory role in vocal loudness control.
- Differentiate between the roles of articulation, respiration, phonation, and resonation.
- Understand the anatomical and physiological bases for voice and speech production
- Understand dynamic relationship between physiology and acoustics for voice and speech production
- Identify and gather necessary information for simple hypothesis generation, and evaluation of viable solutions
- Generate learning issues, evaluation need for research, and reflect on learning process

Recommended background resources:

- Chapters 7 & 8 of Ferrand text (Bring book to work sessions)
- Check D2L weekly as other potential resources may be added throughout the module.

Remember our assigned textbook is not the only resource available to you. You may check out other Speech Science Textbooks from Ms. Pyle's office either during our work sessions or between sessions, seek resources from the library (See 421 Library Guide), and use the internet.

REQUIRED TASKS

Use the following checklist to ensure that your group is completing the PBL required tasks.

1st work period

- ☐ **Read aloud the "Our Roles" section and "Within Group Roles": Spend 10 minutes discussing your experiences and expectations for effective group behaviors– Create your group's 'code of behavior'**
- ☐ **Each group member will select their role (rotate duties across sessions)**
- ☐ **Read the Problem Scenario**
- ☐ **Brainstorm and Create 3-4 specific group learning objectives based on problem scenario and assigned textbook reading.**

It may be helpful to start with what you already know and what elements of the problem are new to you. These specific learning objectives should be <u>meaningful to you</u> and your group and allow you to eventually respond to the questions in the problem scenario. I will meet with each group and make sure your learning objectives are appropriate and on track.

- ☐ **Start with Trigger 1 as a discussion topic and make a list of your questions; Consider options available for answering your questions.**
- ☐ **Assign each group member a task for next session: topic, term, instrumentation item, or question to research and briefly teach group about during 2nd work period (This will be repeated with new assignments each work period thereafter). Essentially - Brainstorm, Prioritize, Research, Question, Repeat.**
- ☐ **Determine if you have a specific question that your group would like addressed by facilitator (group recorder should document)**
- ☐ **Group Recorder will post session notes from session within 24 hours to collaborative document and post in D2L discussion board.**

Use the following checklist to ensure that your group is completing the PBL required tasks.

Typical Plan 2nd, 3rd Work periods

- ☐ **Group Discussion/Individuals report on findings on assigned tasks. TEACH/SHARE with your peers (15 minutes) ***
  - **Follow-up on Trigger 1 and move on to Triggers 2 & 3**
- ☐ **Active learning Activity – Generate Concept Map (Learning Artifact)**
- ☐ **Group Meeting with Facilitator**

4th Session: Group Report

- ☐ **Turn in Concept Map or other Learning Artifact (One per group)**
- ☐ **Participate in <u>Class Discussion</u> on your response to the Problem Scenario.**
  - **Be prepared to share your group's response to problem questions, learning objectives & rationale; including resources you found helpful**

- ☐ **After class: (Individually) Complete Peer Review of Participation Form and submit a one-page reflection D2L**
    - **Examples of questions you may wish to consider:**
        - **Was there a concept or idea that was new to you or now more fully realized after completing the module?**
        - **What have you learned through this process? Are there concepts you do not yet fully understand.**
        - **Will you approach your learning in the next module differently, if so how/why?**

Our Roles: Student & Facilitator

Reminder in a PBL format – we are all working together (students and instructor) to construct meaning for the content areas of this course. I consider us all partners in this process and it requires us all to appreciate that we all bring unique perspectives, varied interpretations of information, and relevant questions.

This method is used to develop our critical thinking and reasoning skills so we can become self-directed and life-long learners (key attributes in the fields of Audiology and Speech Language Pathology and also important for preparing for the demands of graduate and doctoral level courses, not to mention life in general ☺) Remember, I care about your learning experience and my goal for you is to simultaneously gain knowledge, enjoy the learning experience, and develop your personal competence for critical thinking and learning.

Expectations for Students – Actively engage with materials and generate questions, complete assigned tasks, share/collaborate with peers, communicate with Instructor and graduate assistant on "fuzzy" points. Remember, questions are not dumb, the technical details of these speech science topics can be complicated and when you are first learning about them, it is important that you understand that the more you engage and think about the concepts, the easier they will become part of your knowledge base. I guarantee you are not the only person who may need clarity on a topic during this process. In a few words: show up, encourage/support each other, ask questions and interact, – this should be a fun experience. We learn as we teach others.

Expectations for Instructor and Graduate Assistant – (Facilitator/Tutor) – Assign background readings, clarify/inform, facilitate questions/concerns in learning process, facilitate skill labs and concept map formation. Provide guiding feedback on question development, learning objectives, content in general. – In a few words: support your learning process, guide not dictate.

PBL Group ROLES

For each work session during this module, each group member will have an assigned "role" (see below for description) – As a group decide how you want to rotate the tasks and indicate in your group meeting notes – what role people were assigned during each meeting.

Discussion Leader - Duties: Keep group on track during discussion – review and monitor required task checklist – attempt to maintain full engagement of all group members during group discussions

Recorder/Note taker Duties: Post list of each group member's assigned research tasks – take notes for the group meeting and post on collaborative document; convene group outside of class if needed. Post group's learning objectives

Accuracy Coach/Fact Checker – Duties: Review each group members posted information in collaborative documents and learning artifacts; raise questions about discrepancies; ensure all resources are properly cited.

Reporter/Reader – Read aloud problem or other items of interest to the group during meetings; – a key spokesperson during whole class discussions

APPENDIX B

OBSERVATION RUBRIC

APPENDIX B: Observation Date: _____ Time Started: _____Time Ended: _____ (Observe for 15 minutes) Initials:_____
Indicate if observation occurred during 1st 2nd 3rd 4th observation interval during the class period.

Observed Behaviors																
Circle Chair **Check if laptop or device present**	**Talking (VERBAL)**							**NON-VERBAL (OBSERVE 1st for all students)**								
								Listening		**Reading or Research**	**Organizing action ***	**Writing Notes**	**Other Behaviors**	**Total**	**Comments**
Group # _____	**Questioning**	**Confirming**	**General Commenting**		**Specific Commenting Personal Experience or Prior (E) Knowledge (K)**	**Suggesting items for action plan or directives**	**Reading aloud to share knowledge**	**Eye on Speaker**	**Contemplating**	**T – written text M- electronic media**	**White board to organize or on shared document (e.g. graphic organizer)**	Handwritten (H) or Typing (T)	**(Describe on back if needed)**		
			ON TOPIC	OFF TOPIC											
Student Code															
Student Code															
Student Code															
Student Code															
Student Code															
Student Code															
Totals															

Write General Observational Comments and/or Descriptions of group interaction on back

Overall impression of # of Students on-task during observational period (Circle one)
Half or less More than half Almost all (Group size -1) All

APPENDIX C

INFORMED CONSENT STATEMENT

SLHS 421 Course Syllabus Addendum Spring 2017

UNIVERSITY OF NORTH DAKOTA
Institutional Review Board
Informed Consent Statement

Title of Project: **Using Problem Based Learning in Speech Language Pathology**

Principal Investigator: Elaine Pyle, 701-238-3654; pyleel@mnstate.edu
Doctoral Student, Department of Teaching and Learning
University of North Dakota

Advisor: Woei Hung, Ph.D.; 701-777-3486; woei.hung@email.und.edu
Professor, School of Teaching and Learning: Instructional Design
University of North Dakota

Purpose of the Study:
The purpose of this research study is to explore using Problem Based Learning (PBL) as an instructional approach in the discipline of Speech, Language, and Hearing Sciences curriculum. This study is for the principal investigator's dissertation research.

Procedures to be followed:
As a participant in this study you will not need to follow any special procedures other than engaging in the normal, instructional practices and assignments as outlined in your SLHS 421 course syllabus. During the semester, a teaching assistant, who is also a paid research assistant will be present in the classroom collecting observation data on student participation in regular learning activities of PBL.

Risks:
There are no risks in participating in this research beyond those experienced in everyday life or in the daily routines of the classroom.

Benefits:
- By participating in this research, you might learn more about how Problem Based Learning affects you in learning SLHS 421 course content.
- This research might provide the investigator with a better understanding of how to design PBL problems for mastery of instructional content.

Duration:
All research activities will occur during the regular course starting and ending dates for the spring 2017 semester.

Approval Date: NOV - 3 2016
Expiration Date: NOV - 2 2019
University of North Dakota IRB

APPENDIX D

TABLE OF THEMES, CATEGORIES, AND CODES

Theme	Categories and Codes

THEME 1 - PERSONAL RELATEDNESS TRANSPIRED FROM SUBJECT AND PROBLEM CHARACTERISTICS
 	
-Individualized personal relatedness transpired from a variety of problem and subject characteristics embedded within PBL problem design creating heightened perceptions of problem realism and supporting ongoing interest for engagement with PBL learning activities. (RQ1)
	• **Prior experiences**
	  ○ clinical disorder
	  ○ family or friend
	  ○ self
	• **Personal interest**
	  ○ subject attributes
	  ○ clinical disorder
	• **Career interest**
	  ○ future work setting
	  ○ supports multidisciplinary collaboration
	  ○ Unique or novel aspect of profession
	• **Emotion/Empathy**
	  ○ quality of Life
	  ○ family/Caregiver
	  ○ personalization of subject
	  ○ relatedness to self
	  ○ relatedness to familiar person
	  ○ relatedness to Problem subject
	  ○ utility of Problem solution
	• **Similarity Subject characteristic/attributes**

Theme	Categories and Codes

THEME 2 STUDENT MOTIVATION AND ENGAGEMENT VARIED WITH PERCEPTIONS OF PROBLEM DIFFICULTY AND PRIOR KNOWLEDGE (RQ1)
 	
-Low prior content knowledge combined with high problem complexity created feelings of stress in PBL modules. (PBL 3 & 4)
-Higher levels of prior knowledge and/or overlap with prior or concurrent courses with related content supported learning and identification of relevance of problem during the initial PBL modules when uncertainty of PBL process and PBL structure was high. (PBL 1 & 2)
-Low levels of prior knowledge or unfamiliarity of content areas and content difficulty provided a challenging, yet motivating element for facilitating individual research, peer collaboration (i.e., increasing reliance on peers for research and peer teaching), for a deeper understanding of content knowledge RQ1 (PBL 3 & 4)
	• **Content Overlap**
	  o Prior courses
	  o Concurrent courses
	• **Low Prior Knowledge**
	  o Reliance on research
	  o Reliance on Peers
	  o Reliance on Facilitator
	  o Less initial discussion
	  o Additional Time needed
	• **Novelty of less familiar content area**
	• **Familiarity of content**
	  o Reduced stress
	  o Facilitated deeper learning
	• **Feelings of Stress**
	  o Unfamiliarity/uncertainty with PBL process
	  o Low prior content knowledge
	  o high complexity of problem scenario
	• **PBL Problem**
	  o Difficulty of content knowledge
	  o Complexity of problem scenario
	  o Novelty/Unique
	  o High volume of information

Theme	**Categories and Codes**

THEME 3 –NATURE OF ENGAGEMENT SHIFTED FROM COMMUNITIVE TO RESEARCHING (RQ1)
-The nature of engagement and declining adherence to steps of PBL (i.e., fatigue) was impacted by problem difficulty, problem complexity, and low prior knowledge, necessitating a shift in the nature of engagement from communitive to researching oriented (i.e., verbal to non-verbal) as a form of engagement.
	• **PBL Problem**
	  o Difficulty of content knowledge
	  o Complexity of problem scenario
	  o Novelty/Unique
	  o High volume of information
	• **Problem complexity**

THEME 4 – DIRECT INTERACTION WITH PROBLEM SUBJECT AND SOLUTION VALUE ENHANCED ACCOUNTABILITYAND REALISM (RQ1 - PBL 4)
-Direct face-to-face interaction with the problem subject and perceived value/necessity of problem solution created feelings of accountability prompting engagement in PBL collaboration and research activities.
-The perceived value of problem solution was important and meaningful in the face-to-face interaction, creating a sense of urgency, purpose, and interest to engage in research for problem solving.
-Applicability and immediacy of problem solution to a familiar setting with close proximity facilitated authenticity of problem.
-Peer Feelings of personal accountability, pride, and responsibility to help problem subject occurred in PBL with face-to-face interaction.
	• **Necessity of problem solution**
	  o immediate need
	  o impacts familiar peers
	  o impacts self
	  o meaningful
	• **Future career interests and aspirations**
	  o Work setting
	  o Multidisciplinary collaboration
	  o Communication with patients and caregivers
	• **Responsibility for Peers**
	  o Peers' Learning
	  o Personal mastery/knowledge
	  o Accountability for research
	  o Equivalent Effort
	  o Equitable distribution of work
	• **Responsibility to Problem Subject**
	  o Pride
	  o Value
	  o Empathy for Situation
	  o Utility of Solution
	  o Necessary Solution
	  o Immediate Need
	• **Problem Solution**
	  o Utility
	  o Open-ended/Multiple solutions
	  o Ownership

Theme	**Categories and Codes**

THEME 5 GROUP DYNAMICS and PBL SUPPORTS FOSTERED POSITIVE LEARNING EXPERIENCE. (RQ3)
 	
-Positive, evolving peer group dynamics combined with gradual comfort with the structure of PBL (i.e., assigned roles, learning artifacts, group reporting) were constructive supports for sustaining engagement and creating a positive learning experience, affording a context for collaboration, accountability and organization of knowledge.
-Artifacts of the PBL structure provided a shared focus for student engagement via PBL roles, trigger questions, peer teaching, and group reporting
	• **Learning Artifact**
	  o Autonomy in varying the Learning Artifact
	  o Efficiency
	  o Organization
	  o Accountability of Effort
	• **Acclimation to PBL Structure**
	  o Anxiety
	  o PBL Roles
	  o PBL Trigger Questions
	  o Peer Teaching
	  o Group Reporting
	  o Gradual comfort with PBL process
	• **Group dynamic**
	  o Positive
	  o Negative
	  o Prior group experiences
	• **Facilitator interaction**
	• **Interaction with Instrumentation/Technology**
	• **Enjoyment**
	  o relaxed learning atmosphere
	  o positive group dynamic
	  o hands on interaction with technology

APPENDIX E

Findings for ANOVA Tukey post hoc comparisons between problems

TOTAL (Verbal + Nonverbal)	Mean Difference	*SE*	*p*
PBL1 - PBL2	-6.63	4.44	.44
PBL1 - PBL3	10.6	4.44	.082
PBL1- PBL4	8.54	4.44	.222
PBL2 - PBL3	17.26	4.44	<.001**
PBL2 - PBL4	15.17	4.44	.004*
PBL3 – PBL4	-2.09	4.44	.996

Note: *The mean difference is significant at p <.01 level;
**The mean difference is significant at p < .001

VERBAL	Mean Difference	*SE*	*p*
PBL1 - PBL2	-1.17	4.8	.99
PBL1 - PBL3	15.4	4.8	.001*
PBL1- PBL4	9.34	4.8	.105
PBL2 - PBL3	15.58	4.8	<.001**
PBL2 - PBL4	10.52	4.8	.052
PBL3 – PBL4	-6.06	4.8	.449

Note: *The mean difference is significant at p <.01 level;
**The mean difference is significant at p < .001

NONVERBAL	Mean Difference	*SE*	*p*
PBL1 - PBL2	-5.46	1.17	<.001**
PBL1 - PBL3	-4.78	1.17	<.001**
PBL1- PBL4	-.80	1.17	.902
PBL2 - PBL3	.67	1.17	.94
PBL2 - PBL4	4.65	1.17	.001*
PBL3 – PBL4	3.97	1.17	.005*

Note: *The mean difference is significant at p <.01 level;
**The mean difference is significant at p < .001

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