Illuminating the Liminal Space of Learning in Project-Based Pedagogy: Something We Can Learn from CTE Teachers

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Abstract

While existing evidence has indicated that teachers employing Project-Based Learning (PBL) contribute to improved student learning outcomes, there is a notable lack of data investigating how these educators articulate their roles in the teaching process (Kaplan & Garner, 2017; Leng et al., 2018). The aim of this qualitative descriptive study was to investigate how high school teachers, utilizing PBL, conceptualized their roles concerning questioning students, and fostering student inquiry in the western United States. The study's conceptual framework incorporated Arman's (2018) Student-Centered Approach Theory and Dobber et al. (2017) Direction of Inquiry Process Continuum Model. Driven by two research questions, the first inquiry centered on the teachers' role in questioning students, while the second explored their role in stimulating students to ask questions. The study involved a sample of ten PBL teachers, predominantly individuals who transitioned from professional backgrounds into the teaching profession. The findings revealed distinct teacher actions and roles, portraying PBL as a catalyst for a diverse range of learning modalities. The subsequent discussion probes into the liminal spaces of learning inherent in the interactions between teachers and students. The conclusion drawn is that PBL pedagogy involves purposeful tasks encompassing both building and fostering, a natural extension of secondary pedagogy, ultimately enabling students to surpass the teacher.

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In the dynamic landscape of modern education, Project-Based Learning (PBL) emerges as a beacon of innovation, captivating the imagination of educators in the 21st century (Bell, 2010; Lattimer & Riordan, 2011; Morrison et al., 2021). Picture a classroom where inquiry-driven, student-centric teaching takes center stage, pushing the boundaries of traditional education. PBL invites educators to navigate a spectrum of inquiry directions—student-led, teacher-guided, and a blend of both—transforming the learning journey into a captivating exploration (Arantes & Lino, 2018). Amidst the acclaim for its ability to amplify learning outcomes (Lazonder & Harmsen, 2016; Serin, 2018; Üzüm & Pesen 2019), a question lingers in the minds of educators: What role do teachers play in this student-centric orchestration of knowledge?

It is common knowledge in teacher preparation that there is a continuum that runs from teacher-centered instruction to student-centered instruction. PBL invites a double shift: one towards a student-centered, and the second, from instruction to learning (Tang, 2023). It is this shift, creating opportunities for student-centered learning, that traditional teacher preparation programs can capitalize on to transform new teachers. PBL has grown in recognition as valuable in teacher preparation programs, but not normalizing it as part of new teacher preparation remains an uphill climb. While some institutions value PBL and attempt to incorporate it (Tempera & Tinoca, 2022), faculty often do not understand proper application (Alrajeh, 2020). As we investigated the phenomenon of PBL, we embarked on a qualitative descriptive study set against the backdrop of high school classrooms in the western United States. Here, the narrative unfolds, unveiling the intricate dance of high school teachers using PBL—posing questions, nurturing student inquiry, and sculpting an environment where curiosity thrives. Anchored in the Student-Centered Approach Theory and the Direction of Inquiry Process Continuum Model, this study ventures to untangle the mystery surrounding the roles of these educators. As we unravel these insights, we not only enrich the existing literature on student-centered approaches, PBL, and inquiry-based instruction, but also open doors to a new era of exploration and innovation in education.

Review of the literature

Growing Popularity of Project-Based Learning (PBL) in Education

As an increasing number of educators embrace PBL (Serin, 2018), it becomes crucial to explore the literature surrounding student-centered instructional practices and the liminal space involved in transitioning to a new state of mind or teacher direction. The popularity of PBL has been assessed across various global locations, including the United States (Allison, 2018), India (Talat & Chaudhry, 2014), Turkey (Bedir, 2019), and Indonesia (Mali, 2016).

Evolution of the Educational Learning Environment

Over the past two decades, the educational learning environment, particularly the classroom, has evolved from being "teacher-centered" to "student-centered" (Ghafar, 2023; Wang, 2023). This shift reflects a broader pedagogical transition towards active, collaborative learning, where the focus moves from the teacher to the student (Cheney & Terry, 2018). The integration of technology in the 21st century has played a crucial role in this transformation, turning traditional classrooms into spaces where educators act as facilitators rather than central lecturers. Theories such as Paragogy and methodologies like PBL have been instrumental in fostering this change, promoting the development of 21st-century skills and redefining the roles of both teachers and students in the learning process.

Approaches like STEM (Science, Technology, Engineering, Mathematic) STEAM (Science, Technology, Engineering, Art, Mathematic), and Career and Technical Education (CTE) further promote student-centered learning by shifting classroom dynamics and enhancing engagement. These methods emphasize interdisciplinary, real-world applications of academic concepts, encouraging active learning, problem-solving, and the development of professional competencies in STEM subjects (Helmi et al., 2019; Berglund et al., 2021). Student-centered STEM environments, particularly when implementing integrated STEM (iSTEM) approaches, have been shown to significantly increase student engagement and improve learning outcomes, especially in mathematics at the middle school level (Struyf et al., 2019; Izzah & Mulyana, 2021).

Teachers transitioning to student-centered pedagogy may experience shifts in their roles and identities, with some embracing the change and others finding it challenging (Keiler, 2018). PBL, a cornerstone of student-centered learning, forms the basis of the curriculum rather than serving as a supplementary activity. Blended learning environments that incorporate student-centered active learning approaches have demonstrated improvements in students' mathematical performance, their ability to coordinate multiple semiotic representations, and overall satisfaction with alternative teaching methodologies (Capone, 2022). These findings suggest that STEM, STEAM, and CTE approaches effectively support student-centered learning across various contexts and subjects, preparing learners for the challenges of 21st-century careers by fostering higher-order thinking skills and real-world problem-solving abilities (Helmi et al., 2019; Nanney, 2020).

Student-Centered Learning: A Constructivist Approach

Student-centered learning is fundamentally rooted in constructivism theory, which posits that learners actively construct knowledge through their experiences (Chand, 2023; Efgivia et al., 2021). This approach is grounded in the work of theorists like Piaget, Vygotsky, and Bruner, who emphasized cognitive development through disequilibration and social interaction (Chand, 2023; Efgivia et al., 2021). Lev Vygotsky (1978) significantly contributed to the constructivist model by highlighting the role of social interaction in knowledge development, underscoring the

importance of creating opportunities for students to learn from their inquiries or more skilled peers.

In constructivist classrooms, teachers act as facilitators, guiding students to build their own understanding rather than merely transmitting information (Chand, 2023; Efgivia et al., 2021). This method fosters active learning, critical thinking, and conceptual understanding (Bada & Olusegun, 2015). It also holds substantial implications for fields like nursing education, where promoting active learning and student engagement is crucial (Abualhaija, 2019).

Implementing constructivist teaching effectively requires educators to continuously reflect on their practices and develop learning environments that encourage ongoing assessment and exploration (Bada & Olusegun, 2015). Ultimately, constructivism represents a paradigm shift towards student-centered learning, aiming to improve educational outcomes by placing students at the center of the learning process (Bada & Olusegun, 2015).

Student-Centered Teacher Roles and Institutional Practices

Student-centered learning (SCL) approaches are increasingly advocated in STEM/PBL education but implementing them effectively requires significant shifts in teacher roles and practices. Studies have identified discrepancies between teachers' espoused and enacted SCL practices, often due to traditional beliefs and systemic barriers (Onurkan & Özer, 2017). Successful SCL implementation is associated with professional development in Information and Communication Technology (ICT), individualized learning, and the incorporation of student feedback and assessments (Zhang et al., 2021). Teachers transitioning to SCL classrooms experience varying degrees of identity shifts, with some embracing the change while others struggle or resist (Keiler, 2018). Even teachers reputed for student-centered instruction may employ a mix of student-centered and teacher-centered management strategies, reflecting principles of "good classroom management" derived from traditional classrooms (Creswell, 2008). These findings highlight the need for targeted teacher training programs to support the adoption of student-centered roles and practices in modern classrooms.

Shift Towards Student-Centered Approaches

New educational theory suggests paragogy (peer assisted learning) over pedagogy, tackling the task of collaboratively creating a beneficial and encouraging environment for self-directed learning, emphasizing the connectedness among peers in the digital age (Herlo, 2014). Teachers embracing student-centered practices are required to forge new beliefs about the process of learning and their roles (Ndoci Lama et al., 2018). Further exploration was recommended within each type of student-centered instructional practice to develop a more profound understanding of this teacher transformation (Leng et al., 2018).

Benefits of Student-Centered Learning

U.S. educators turn to student-centered education, faced with the challenges of eroding public confidence and high failure rates (Levesque-Bristol et al., 2019). Linked to elevated student learning outcomes, the implementation of student-centered learning practices plays a

critical part in making educational programs more significant and interesting to learners. A study focusing on student-centered approaches revealed that university candidates exposed to highly student-centered classrooms reported significantly increased levels of perceived competence, the ability to transfer knowledge to other relevant courses and experiences, higher learning gains, and a greater sense of self-determined motivation (Levesque-Bristol et al., 2019).

Challenges of Student-Centered Learning

Researchers contend that despite the advantages associated with student-centered practices, teachers grapple with several challenges (Ramnarain & Hlatshwayo, 2018). Seasoned educators express concerns that student-centered approaches can lead to chaos and disorder in the classroom (Ndirangu, 2017). Logistical issues, including a shortage of time, administrative support, and the difficulty of holding students accountable, are also cited by some teachers (Edwards, 2019). Although constructivists advocate for student-centered practices, many teachers find it to be a demanding pedagogy (Kemp, 2013).

While school administrators expect teachers to adopt student-centered practices, educators encounter difficulties due to inadequate support and understanding. Onurkan Aliusta and Ozer (2017) highlight that many teachers struggle to empower students because of a lack of confidence in their abilities and limited knowledge on delegating learning responsibilities. They suggest that teacher training should align with student-centered practices, given that teachers often teach as they were trained. The global endorsement of student-centered practices further complicates the effective implementation of these approaches, especially when traditional teacher-centered roles persist (Lee & King, 2022). Kemp (2013) emphasizes the necessity for a clearer understanding of the student-centered teacher role for educators to embrace this pedagogical shift.

Relationship Between Teacher Role and Student-Centered Approach

Researchers unveil a correlation between teachers' roles and their educational practices. Kaplan and Garner (2017) argue that the successful implementation of student-centered instructional practices hinges on the alignment of teachers' roles with the underlying pedagogical philosophy, such as the student-centered approach. Extensive research establishes a close link between teachers' roles and their educational approach, student-centered (Garcia-Cepero & McCoach, 2009; Lavinia & Lawson, 2019; Mahasneh, 2018). Mahasneh's (2018) study specifically identifies a connection between teacher efficacy and project-based learning, while Leng et al. (2018) highlights a relationship between teacher roles and student-centered instructional practices.

The implementation of student-centered instructional practices is intertwined with teachers' roles, and these roles exert a notable influence on student outcomes. Role descriptions for high school STEM teachers, as documented by Morrison et al. (2021), recommend explicit teaching about PBL in teacher preparation. Keiler (2018) sheds light on the role descriptions of

13 middle-school STEM teachers, outlining the potentialities and challenges encountered in student-centered classrooms.

Various authors advocate for a focused exploration of the roles assumed by student-centered teachers to enhance 21st-century learning skills and provide support for educators (Serin, 2018; Gammons et al., 2018). Research underscores that teachers embracing student-centered instructional practices, such as PBL, adopt different responsibilities, prompting them to assume new roles (Murphy et al., 2021). This study specifically delves into the examination of project-based learning.

Project-Based Learning (PBL), A Student-Centered, Inquiry-based Instructional Practice

Project-Based Learning (PBL) is frequently identified as student-centered inquiry-based learning. Hmelo-Silver et al. (2009) assert that project-based learning stands out as an effective student-centered practice. The terminology arises from the core characteristic of PBL, positioning the student at the focal point of the learning process by tasking them with project completion through an inquiry-based approach. Additionally, DeMink-Carthew and Olofson (2022) characterize PBL as a student-centered instructional method, emphasizing a dynamic nature. The approach necessitates higher-order thinking skills for problem-solving and knowledge construction (Morrison et al., 2021). Alternative terms commonly used interchangeably with PBL include inquiry-based learning and problem-based learning (Dobber et al., 2017).

Cultivating Preservice Teachers through PBL

Project-based learning (PBL) is an effective approach for cultivating preservice teachers' skills and competencies. Research suggests a four-step model for preparing teacher candidates: observe, experience, create, and become PBL practitioners (Zhang et al., 2015). PBL merges theory with practice, encourages self-regulation, and promotes teamwork in teacher education courses (Amerstorfer, 2020). It also fosters digital competence development among preservice teachers, with studies reporting high satisfaction and self-reported improvement in digital skills (Alonso-Ferreiro, 2018). When implementing PBL units, preservice teachers face both successes and challenges, including engaging students in relevant learning, maintaining rigor, and involving the community as partners (Lee & Galindo, 2021). The implementation of PBL requires a shift from traditional teaching practices and a reconceptualization of mathematics teaching and learning. Overall, PBL is recognized as a valuable instructional model for preparing preservice teachers in various educational contexts.

Teacher Direction in PBL Instructional Practices

The pivotal role of the PBL teacher emerges as a significant predictor of elevated student learning outcomes, prompting an imperative exploration into the nuanced dimensions of the PBL educator's role. While PBL does not advocate for a complete absence of teacher lectures or teacher-centered activities, the predominant responsibility of teachers is to establish the

foundation for effective problem-solving skills, thereby setting the stage for inquiry (Chang & Wang, 2009).

Serin (2018) underscores the indispensability of "teacher direction," asserting that in the absence of adequate direction from teachers, attaining higher learning outcomes in a student-centered project-based classroom becomes unattainable. Arman (2018) delineates "teacher direction" in project-based learning through two distinct applications: teacher-directed inquiry and student-directed inquiry. The term refers to the extent to which teachers provide guidance throughout the inquiry process as teacher-directed and/or student-directed.

Teacher Direction as Teacher-Directed Inquiry

In teacher-directed inquiry, PBL teacher direction, the teacher takes charge of determining the questions to be explored and the methods of investigation (Dobber et al., 2017). Ramnarain and Hlatswayo (2018) characterized this role as the teacher providing guidance by explaining the investigation to the students, directing the study's objectives, offering content rules, creating study materials, distributing them, advising students on completion, and emphasizing the importance of following directions. Unlike a teacher-centered approach where knowledge is imparted, in teacher-directed inquiry, the teacher guides students in the process of investigation and discovery, making it a student-centered approach despite being teacher-led.

Teacher Direction as Student-Directed Inquiry

In student-directed inquiry, PBL teacher direction, students take the initiative in deciding what and how they want to study, with the teacher providing a supportive role by setting the stage and guiding or facilitating the process when needed. Within the framework of student-directed inquiry, students autonomously choose their topics, questions, data collection methods, and other parameters. While teachers exert less overt influence, they play a supportive role in assisting students to consider the most effective ways to represent their data (Dobber et al., 2017). This approach fosters deeper learning by allowing students to pursue their interests and develop critical thinking skills (Levy, 2013). Research suggests that student-directed inquiry enhances engagement, motivation, and the ability to apply knowledge in real-world contexts (Hmelo-Silver et al., 2007). Teachers, therefore, act as facilitators, providing necessary resources, scaffolding, and feedback to guide students through their learning journey (Kuhlthau et al., 2015).

Conceptual Framework

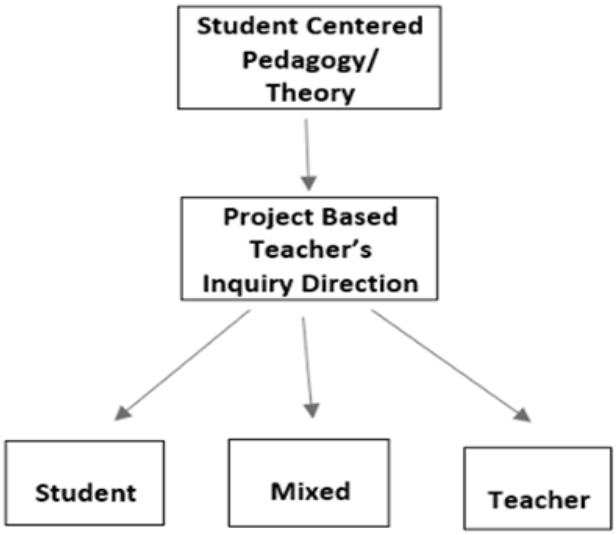
The conceptual framework for this study was constructed based on the Inquiry Process Continuum Model and the principles of the Student-Centered Learning Approach (Aramn, 2018; Dobber et al., 2017). Both the Inquiry Process Continuum model framework (Dobber et al., 2017) and Arman's (2018) Student-Centered Theory incorporate elements pertaining to teacher interactions within project-based classrooms. Therefore, the integration of these models provided a fitting conceptual framework for describing the role descriptions of high-school educators employing project-based student-centered instructional practices.

The Student-Centered Learning Approach Theory speculates that students bear responsibility for their learning, emphasizing their central role in the learning process (Arman, 2018). According to Fierke et al. (2014), this approach employs learning methods enabling students to construct their knowledge through an inquiry-based process.

Regarding the process of teacher direction in inquiry, the Inquiry Process Continuum Model identifies two teacher directions: student-directed inquiry and teacher-directed inquiry, with mixed-directed inquiry referring to a blend of both. Furtak et al. (2012) reveal that in project-based, student-centered instructional practices, a dynamic exchange of responsibility for learning occurs between teacher and student due to inquiry direction. The codes in the Inquiry Process Continuum Model (Dobber et al., 2017) represent positions along a continuum from entirely student-directed inquiry to entirely teacher-directed inquiry. Figure one presented illustrates the synthesis of theory and model.

Figure 1

The Student-centered Theory, Project-Based Teachers' Roles of Inquiry Direction Conceptual Framework



Method and Design

A qualitative descriptive design was employed in this study to explore the individual and group experiences of high school PBL teachers. This approach allowed for the exploration of common conceptions arising from their reflections. The decision to adopt a descriptive design was influenced by the recommendations of Keiler (2018) and Morrison et al. (2021), who emphasized the importance of investigating high school teachers using PBL in the context of teacher preparation.

Furthermore, the call by Kaplan and Garner (2017) and Leng et al. (2018) for a deeper examination of the relationship between student-centered instructional practices and teachers' roles, as well as Mahasneh's (2018) advocacy for more qualitative research exploring the close connection between teachers' roles and educational practices, collectively identified a gap in the literature. This gap prompted a need to investigate the directional role descriptions of teachers utilizing PBL for enhanced teacher preparation, as highlighted by Kaplan and Garner (2017), Keiler (2018), Leng et al. (2018), Mahasneh (2018), Morrison et al. (2021), and Serin (2018).

In light of these considerations, a quantitative method was deemed unsuitable, leading to the selection of a qualitative approach with a descriptive design. The research questions focus on unraveling how high school teachers, employing project-based student-centered instruction, articulate their roles in terms of teacher direction. This encompasses aspects such as asking students questions and stimulating students to question, with the ultimate goal of enhancing project-based learning and advancing teacher preparation.

Participants

The study focused on instructors delivering PBL courses at the research site, constituting approximately 78 teachers. The selection of instructors for the sample was based on convenience sampling (Patton, 2014), with a specific emphasis on instructors within one academic division at the research site. Ultimately, a sample of 10 instructors, responsible for teaching high-school PBL CTE student-centered courses across four distinct high school campuses, willingly agreed to participate in the study.

Data Collection Technique and Research Instrument

To address the research questions, two primary sources of data were employed: individual semi-structured interviews and two focus groups. Before the formal data collection, a field test of the research instrument and protocol was conducted to ensure the generation of data aligned with the actual study objectives.

The initial data source involved individual semi-structured interviews with 10 high school teachers specializing in PBL courses. A 21-question interview format was adapted from various sources such as transforming pedagogy (Dole et. al., 2016; Oppong-Nuako et al., 2015) PBL, and existing literature (Han et al., 2014; Lee & King, 2022). Specifically designed to address all research questions, the interview questions sought participants' insights into the impact of their roles in PBL (Dobber et al., 2017; Serin, 2018).

The second data source comprised two focus groups, each involving four teachers selected from the initial pool of 10 participants in the individual semi-structured interviews. Due to time constraints and scheduling conflicts, two of the initial 10 participants were unable to participate. According to Carlson (2010), focus groups are instrumental in theory development and often support primary data collection. Members of these focus groups were presented with six prompts, fostering group discussions while the researcher documented the interactions. This approach aimed to allow participants to elaborate on the phenomenon and provide additional

insights not captured in the individual interviews. Such focus group dynamics, as asserted by Rosenthal (2016), contribute to a more comprehensive description of the phenomena. Krueger (2014) suggested that a focus group interaction is most effective when interviewees share similarities; hence, this study deliberately selected participants employing project-based, student-centered instructional practices to facilitate theory development.

Data Analysis

Inductive thematic analysis, guided by Saldaña's (2021) four-step approach, was employed to scrutinize the qualitative descriptive data. This method facilitated the development of a codebook without imposing predefined theories on the data, allowing the researcher to extract meaning organically.

Analyzing the data gleaned from the 10 semi-structured interviews and two focus groups, the researcher initially identified 251 codes, representing discrete parts or succinct expressions capturing each participant's experience. Emphasizing the participants' voices, these codes were treated as fundamental units (Saldaña, 2021). Subsequently, these initial codes were organized into 38 categories, with similar codes being grouped and analyzed within the same category. Each category underwent thorough revision, exploration, and review for shared characteristics, leading to the identification of three higher-level categories that were later refined into six common themes.

In the third analytical step, the researcher established connections between categories, resulting in the generation of six themes. Notably, two hidden teacher attributes (Building & Fostering) emerged through analytic memo writing within three initial themes/high-level categories, contributing to the final set of six themes. In the conclusive step of data analysis, these established themes were systematically related to Research Questions 1 and 2, providing a comprehensive and insightful understanding of the study's outcomes.

Validity and Reliability of Research Instruments

To safeguard the trustworthiness of the analysis, a comprehensive array of measures was implemented, including member checking, interview protocols, an expert panel review, a field test, and triangulation of data. Yazan asserts that trustworthiness is built upon adherence to research questions and the acquisition of data that enhances the study's comprehension.

An expert panel comprising five individuals with terminal degrees critically examined the interview questions, ensuring alignment. The semi-structured interview and member checking guides were adjusted based on their constructive feedback. The researcher conducted a field test with three non-participant teachers in similar positions, gauging interview length and obtaining valuable feedback.

During the data collection phase, the researcher maintained a written personal journal to mitigate potential biases. Yazan (1995) suggests that credibility in qualitative research is achieved through representing multiple perspectives with rich data descriptions, validated by study participants. The researcher took note of any personal connections or feelings related to

participants' responses, later reflecting on potential biases. With these measures in place to strengthen the study's integrity, the examination progressed to analyzing the data collected, leading to insightful findings.

Findings

This investigation into the roles of high school teachers employing PBL centered on two primary research questions. The data, derived from 10 semi-structured interviews and two focus groups, yielded a total of 251 codes organized into 38 categories, ultimately leading to the identification of six essential themes. The first question investigated how teachers described their role in asking students' questions, yielding three key themes (see Table 1).

Table 1

Themes and Conclusions Associated Research Question One

Themes	Conclusion
Building Relevant Learning	PBL teachers build relevant learning through student-centered practical and experiential experiences and teacher to student guidance.
Building Empowered Students	PBL teachers build empowered students through shared thoughts and ideas that promote student-efficacy.
Building a Safe Place	PBL teachers build a safe place through understanding and acknowledging the aspects of the school environment which encourage students to be more engaged.

Building Relevant Learning

This theme unpacks the PBL teacher's responsibility in guiding students toward practical and experiential experiences that are directly applicable to personal aspirations or real-world issues. Teachers emphasized cross-curricular development, industry relevance, and teacher-to-student feedback, underscoring the importance of making learning meaningful. As one participant stated, "I try to connect what we are doing to real-life scenarios, whether it's something they want to do in the future or a current issue they care about." This approach not only engages students but also fosters a deeper understanding of the content. Notably, the study revealed a one-directional relationship with core teachers, indicating a potential area for improvement in collaborative teaching practices.

Building Empowered Students

This theme delves into the PBL teacher's role in promoting shared thoughts, ideas, and student efficacy. Teachers foster a co-learning environment, encouraging students to take the lead and develop confidence through personal reflections and teacher-guided questioning. As one teacher shared, "I step back and let them lead discussions. It's amazing to see how they come up

with solutions I hadn’t thought of." This practice highlights the shift in the teacher's role from a knowledge provider to a facilitator, supporting students in becoming more independent and confident learners.

Building a Safe Place

This theme highlights the teacher's responsibility in creating a supportive environment for student engagement. It underscores the importance of understanding and acknowledging factors that encourage participation. Teachers mentioned the need to create an atmosphere where students feel comfortable expressing themselves without fear of judgment. One participant noted, "I always tell my students there’s no such thing as a dumb question. This helps them feel safe to ask anything they’re unsure about." Such practices contribute to a more inclusive and participatory classroom environment, which is crucial for the success of PBL.

The second research question examined how PBL teachers described their role in stimulating students to ask questions, yielding three distinct themes (see Table 2).

Table 2

Themes and Conclusions Associated Research Question Two

Themes	Conclusion
Fostering Relevant Learning	PBL teachers provide real world/ industry realistic teaching and learning materials for students
Fostering Empowered Students	PBL teachers do not spoon feed students; they emphasize skill learning to support independent content learning.
Fostering a Safe Place	PBL teachers acknowledge student fears in learning and questioning.

Fostering Relevant Learning

This theme underscores the teacher's role in making learning experiences directly applicable to personal relevance or real-world issues. Through real-life learning, hands-on experiences, and student choice, PBL teachers aim to enhance engagement and stimulate student-led inquiry. As one teacher explained, "When students see the relevance of what they’re learning to their own lives, they naturally start asking more questions." This illustrates the direct impact of relevant learning on student engagement and curiosity.

Fostering Empowered Students

This theme explores how teachers motivate students to have a voice and believe in their capabilities. Teachers empower students by allowing them to assume the teacher role, providing incremental learning experiences, and celebrating student abilities. This approach not only reinforces content knowledge but also builds essential skills like leadership and public speaking.

Fostering a Safe Place

This theme emphasizes the teacher's role in creating an environment that encourages students to feel safe and engaged in asking questions. Acknowledging potential fears and fostering an atmosphere where no question is considered dumb are essential components of this theme. One teacher described, "I make it clear from day one that everyone's input is valuable, and there's no judgment here." This practice is vital in creating a learning environment where students feel empowered to take risks and ask questions, which is fundamental to the success of PBL.

PBL Teachers Build and or Foster Learning

The findings from this study underscore the progressive shift toward student-centered learning, with a particular emphasis on the teacher's role in navigating the liminal space within PBL as an instructional practice. This evolving educational paradigm necessitates a deep understanding of how teachers can effectively "build" and "foster" student-centered learning environments, as outlined in tables one and two.

When there is a significant gap between the current state and the desired learning outcome, PBL teachers engage in the crucial act of building learning. One participant articulated this approach: "You just answer a question with a question, and you let them figure it out; you let them answer it." Another teacher, reflecting on their interaction with a struggling student, explained, "It's almost like, you know, you don't know the answer to the question, but let's take five steps backwards. I love those moments where, you know, they don't think they know." These examples highlight the importance of building learning by addressing and supporting the critical domains of fostering relevant learning, empowering students, and cultivating a safe environment.

On the other hand, when the gap between the current state and the desired outcome is narrower, PBL teachers focus on fostering learning. As one participant shared, "I don't ever want to explain something to a student. In the case that I could be helping a student, explain it to another student." This careful balance between building and fostering learning within the liminal spaces demonstrates the adaptability and strategic insight of PBL teachers as they guide students through their educational journey. Another teacher emphasized, "You know I really don't believe in spoon feeding because the sooner they can think for themselves, the sooner they'll be able to excel in all areas." These insights set the stage for a deeper discussion on how PBL influences the evolving roles of teachers and the learning experience itself.

Discussion

Within the liminal spaces of learning, where teacher-student exchanges unfold, PBL emerges as a transformative pedagogical approach that not only enhances the learning experience but also reshapes the dynamics between teachers and students. We are talking about more than the shift from traditional synchronous teaching methods to asynchronous, inquiry-driven exchanges. The double shift in PBL establishes a realm /space in learning where

intellectual rigor and emotional support seamlessly intertwine. Unlike the traditional approach where student-centered learning occurs in the form of a culminating project, PBL establishes the need to learn upfront (Lee & Galindo, 2021). Students use a process of inquiry and problem solving to decipher a complex problem and develop understanding of new content (Lee & Galindo, 2021).

PBL has a track record of being beneficial for student learning yet is still thought of as an approach to learning that is outside the context of traditional pedagogy. While traditional pedagogy embraces the continuum from teacher-centered instruction to student-centered instruction, it stops short of the idea of presenting content through the student-centered inquiry process that PBL offers (Lee & Galindo, 2021). The European Higher Education Area has recognized the value of PBL in preparing teachers to lead, both in terms of content and social justice development (Ortiz-Colón, et al., 2021). PBL's effectiveness in promoting student-centered learning is well-documented. As Serin (2018) notes, PBL's growing popularity is linked to its ability to engage students in meaningful, real-world learning experiences. This study builds on foundational research, such as the work by Allison (2018) and Bedir (2019), who explored the impact of PBL in diverse educational settings. The findings align with the constructivist theories of Piaget, Vygotsky, and Bruner, which emphasize the importance of active, social, and experiential learning (Chand, 2023; Efgivia et al., 2021). With a growing sense of the need for advanced problem solving and life-long learning, initial teacher training should include a thorough understanding of PBL and how it functions to create opportunities for deep learning (Chand, 2023; Efgivia et al., 2021).; Ortiz-Colón, et al., 2021).

The themes identified in this study resonate with these theoretical frameworks, particularly in the emphasis on creating relevant, empowering, and safe learning environments. The shift towards SCL, as reflected in the PBL approach, is not just about changing teaching methods but also about rethinking the teacher's role in the classroom. The alignment of these findings with existing literature strengthens the case for continued exploration and implementation of PBL in diverse educational contexts.

Figure 2 illustrates a traditional synchronous teaching method where all students progress from building to fostering at the direction of the teacher. Exploration of the liminal space of learning by the teacher is typically assessed at the same rate for the whole group, and geared towards the needs of the majority.

Figure 2

Synchronous Movement in Learning Across the Pedagogical Continuum (Whole Group Learning Model: I do, We do, You do)

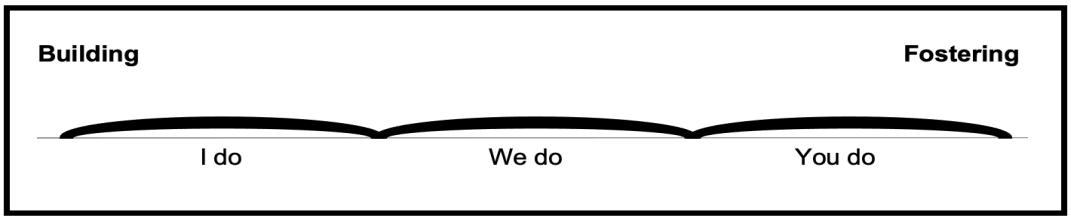
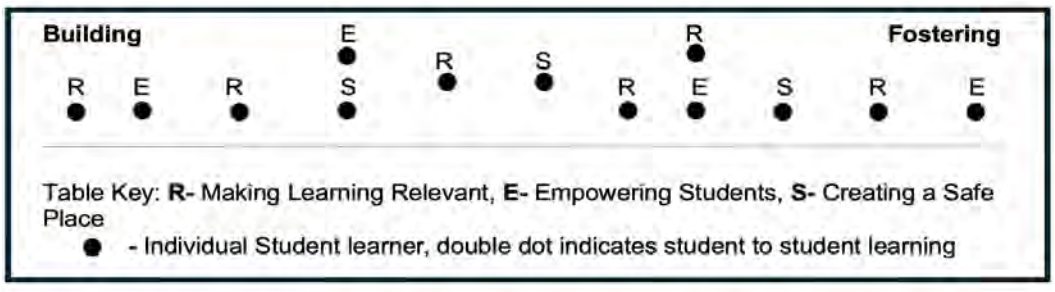


Figure 3 shows the asynchronous movement in learning across the pedagogical continuum as a result of the project-based learning model, with space for unique exchanges and fostering relationships. Here, students may be in a variety of levels of building and fostering. Exploration of liminal spaces by the teacher is typically assessed and supported by PBL curriculum tools (checklist, rubrics, step by step directions, observation, and technology supports) as independent, student to student, or teacher to student interactions, teacher direction, forming unique personalized cases.

Figure 3

Asynchronous Movement in Learning Across the Pedagogical Continuum (Project-based Learning Model: unique exchanges fostering relationships)



Diverging from conventional approaches, PBL liberates teachers from the constraints of lecturing, enabling them to navigate the transitional spaces (also known as the liminal spaces) in learning with greater significance, supporting a wider scope of learning modalities. Within these spaces, PBL teachers possess the flexibility to discern whether to build or foster student learning, with a focus on fostering relationships in three critical areas: knowledge acquisition, skill development, and social-emotional growth, creating meaningfully unique learning experiences for students.

In this dynamic educational space, PBL teachers employ inquiry as a guiding compass, assessing the distance between students' current position and their intended destination. Accordingly, they tailor their approach to ensure effective learning, emphasizing one of the three key aspects: making learning relevant, empowering students, or creating a safe place. This dynamic change in the classroom and instructional culture is challenging; it requires not only a change in pedagogical practice, but in curricula as well (Lee & Galindo, 2021).

Limitations

Despite its limitations, including potential researcher bias, limited experience, a small sample size, and constrained interview durations, the study took deliberate measures to address these challenges and uphold the integrity and transferability of its findings. By actively mitigating these constraints, the research effectively captured the participants' perspectives and provided meaningful insights into PBL.

Additionally, this study was limited to CTE educators. While there is much to be learned from these professional educators, this limits the direct transferability to the core teaching classroom. It should be noted however that PBL has been demonstrated to be effective in core educational settings, the sciences, mathematics, social studies. Lee and Galindo (2021) conducted a very successful study of teaching the practice of PBL to preservice secondary math teachers. It is this connection that makes the results of this study important to teacher preparation programs.

Conclusion

In conclusion, this study serves as a valuable resource for professors within teacher preparation, and prospective teachers alike. It illuminates the multifaceted roles inherent in PBL. The findings not only hold the potential to influence individual teaching practices but also lay the groundwork for broader school training and professional development initiatives. New educators in inquiry can begin with structured, teacher-directed activities and gradually transition to promoting greater student autonomy (Eick et al., 2005). The implications of this research extend beyond the classroom, indicating that PBL can be a powerful approach for all educators seeking to foster an intellectually rigorous and emotionally supportive learning environment.

While the study had its limitations, including potential researcher bias, the researcher’s limited experience, a small sample size, and constrained interview lengths, all of these challenges were carefully addressed to maintain the integrity and transferability of the findings. By ensuring that these limitations were mitigated, the study succeeded in accurately representing the voices of the participants and providing valuable insights into PBL.

These findings underscore the necessity of balancing teacher guidance and student autonomy within learning, in line with the constructivist theories of Piaget, Vygotsky, and Bruner, which advocate for active, social, and experiential learning (Chand, 2023; Efgivia et al., 2021). Preservice teachers' perceptions of inquiry evolved from viewing it as predominantly student-directed to acknowledging the significance of more teacher-guided approaches. This shift

in teacher preparation could empower new teachers to employ PBL in many settings (Biggers & Forbes, 2012, Lee & Galindo, 2021). Central to this discussion is the exploration of liminal spaces in teacher-student interactions, emphasizing the importance of purposeful tasks that both build and foster understanding.

Ultimately, PBL empowers students to move beyond the traditional role of passive learners, facilitating their progression along the continuum toward greater independence. Through PBL, teachers transition into facilitators of knowledge and mentors for both personal and academic growth, contributing to a holistic educational experience that prepares students for real-world challenges.

Implications for the CTE Community

Beyond its broad educational implications, this research highlights a significant opportunity for CTE to play a more prominent role in teacher professional development leadership. As captains of their respective industries, CTE educators bring unique, practice-oriented approaches to teaching that are often overlooked in traditional educational discourse. Their emphasis on real-world applications, experiential learning, and skill-based instruction aligns seamlessly with the principles of PBL.

By leveraging the expertise of CTE teachers, schools and higher education institutions can enrich professional development initiatives, fostering a culture of interdisciplinary collaboration. CTE educators' leadership in this area can bridge the gap between academic theory and industry practice, ultimately equipping both teachers and students with the tools needed to thrive in a rapidly evolving workforce. This study serves as a call to action to elevate CTE teachers as leaders in shaping the future of education through innovative methodologies like PBL.

Despite its limitations, this study contributes to the existing literature on student-centered methodologies, offering a deeper understanding of how to implement PBL effectively. Furthermore, school districts and institutions of higher education can utilize these findings to develop programs that integrate best practices into teacher preparation and professional development, thereby positively impacting teaching practices. This study establishes a foundation for further exploration of PBL across various academic domains, with particular relevance to the CTE field.

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