



**Physical education teacher education impact on the
development of preservice teachers' epistemological beliefs:
A two-year longitudinal case study**

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"do not trust the way you see yourself when your mind is turbulent, and remember that even pain is temporary. honour your boundaries, treat yourself gently, let go of perfection, and feel your emotions without letting them control you. you have enough experience to face the storm and evolve from it."

Yung Pueblo, The Way Forward

Dedicatória

Aos meu pais, sempre...

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Resumo

O objetivo geral deste estudo foi compreender o impacto de um programa de formação de professores de educação física (FPEF) no desenvolvimento e reconfiguração das crenças epistemológicas (CEs) de professores em formação (PFs) através de um estudo de caso longitudinal. Além disso, o estudo procurou obter uma compreensão aprofundada de como as diferentes fases da FPEF orientam a epistemologia dos PFs ao longo do tempo, atendendo às dimensões cognitiva e contextual do desenvolvimento epistemológico. Orientada pelo paradigma interpretativo, esta investigação adotou um estudo de caso longitudinal de dois anos. Onze PFs participaram voluntariamente neste trabalho e foram acompanhados ao longo das diferentes fases neste programa de FPEF. Os dados foram recolhidos utilizando múltiplas metodologias ecléticas e analisados através de análise temática, pela sua flexibilidade interpretativa e alinhamento com o objetivo do estudo. Os resultados sugerem que as CEs na FPEF continuam a carecer de enquadramento conceptual sólido e de investigação empírica, particularmente através de abordagens longitudinais e de domínio específico. O desenvolvimento epistemológico surgiu como inseparável dos processos de socialização profissional e dos contextos pedagógicos. A reconfiguração epistemológica pareceu não linear, caracterizada por períodos de progressão e regressão ligados às exigências contextuais e às respostas emocionais à incerteza. Os currículos baseados em abordagens centradas no aluno, as suas estratégias pedagógicas e os ambientes de aprendizagem social funcionaram como um importante motor estrutural da reconfiguração epistemológica, legitimando a incerteza, a reflexividade e a co-construção do conhecimento. Coletivamente, isto destacou a natureza dinâmica, situada e socialmente mediada do desenvolvimento epistemológico na FPEF e sublinhou a necessidade de um apoio sustentado e sensível ao contexto em todos os programas de formação de professores.

PALAVRAS-CHAVE: CRENÇAS EPISTEMOLÓGICAS, SOCIALIZAÇÃO PROFSSIONAL, FORMAÇÃO DE PROFESSORES, ABORDAGENS CENTRADAS NO ALUNO, EDUCAÇÃO FÍSICA.

Abstract

The general aim of this study was to understand the impact of a physical education teacher education (PETE) program on the development and reconfiguration of pre-service teachers' (PSTs) epistemological beliefs (EBs) through a longitudinal case study design. Furthermore, the study sought to gain an in-depth understanding of how different phases of PETE guide PSTs' epistemology over time, attending to both cognitive and contextual dimensions of epistemological development. Grounded in an interpretative paradigm, this research adopted a two-year longitudinal case study. Eleven PSTs voluntarily participated and were followed across successive phases of the PETE programme. Data were collected using multiple eclectic methodologies and analysed using thematic analysis, for its interpretative flexibility and alignment with the study's aim. The findings indicate that EBs in PETE remain under-theorised and under-investigated, particularly from domain-specific and longitudinal perspectives. Epistemological development emerged as inseparable from professional socialisation processes and pedagogical contexts. Epistemological reconfiguration appeared non-linear, characterised by periods of progression and regression linked to contextual demands and emotional responses to uncertainty. Student-centred approach-based curricula, its pedagogical strategies and social learning environments functioned as a key structural driver of epistemological reconfiguration by legitimising uncertainty, reflexivity, and knowledge co-construction. Collectively, this highlighted the dynamic, situated, and socially mediated nature of epistemological development in PETE and underscored the need for sustained, context-sensitive support across teacher education programmes.

KEYWORDS: EPISTEMOLOGICAL BELIEFS, PROFESSIONAL SOCIALIZATION, PRESERVICE TEACHERS, STUDENT-CENTERED APPROACHES, PHYSICAL EDUCATION.

List of abbreviations

- EBs – Epistemological Beliefs
- PSTs – Preservice Teachers
- PETE – Physical Education Teacher Education
- PE – Physical Education
- OST – Occupational Socialization Theory
- SCA – Student-Centred Approaches
- FG – Focus Group
- RL – Reflexive Log
- POs – Participant Observations
- CoPs – Communities of Practice

Chapter I – Introduction

1.1. Rationale

Over the past five decades, researchers have devoted growing attention to the study of epistemological beliefs (EBs) which refer to the assumptions individuals hold about the nature of knowledge and how it is acquired and justified (Hofer & Bendixen, 2012; Hofer & Pintrich, 1997). These beliefs shape how people interpret information, evaluate evidence, and construct meaning within educational settings (Kuhn & Weinstock, 2002). To better understand them, several theoretical interpretations have been presented, particularly those stemming from general developmental approaches (Kuhn et al., 2000; Perry, 1970) and multidimensional perspectives (Hofer & Pintrich, 1997).

In the field of teacher education, EBs function as powerful cognitive filters that influence how teachers learn and teach. They also play a central role in shaping pedagogical decisions, guiding approaches to curriculum, assessment, and teacher-student interaction (Chan & Elliott, 2004; King & Kitchener, 1994). Despite this influence and the understanding that teacher education has difficulties in aligning EBs with the demands of the contemporary educational paradigm (Bendixen & Feucht, 2010), research has given limited attention to the complex evolution of beliefs throughout the professionalization of teachers.

For this reason, exploring the evolution of preservice teachers' EBs throughout their teacher education journey is particularly pertinent. First, this stage of preparation holds great potential to promote the reconfiguration of such beliefs (Trent, 2011). Second, preservice teachers (PSTs) undergo a process of transformation when they confront the realities, tensions, and dilemmas of professional practice, often triggering a re-evaluation of their epistemological assumptions (Selley, 2013). Considering the potential of this phase, the following sections delve deeper into these dynamics, navigating in greater depth the role of Physical Education teacher education (PETE) programs in shaping PSTs' EBs and the complex interplay between belief development, curriculum structure, and professional learning.

Understanding EBs in Teacher Education

Within educational research, EBs are central to understanding how teachers and learners interpret information, evaluate evidence, and construct meaning. Early developmental models such as those proposed by Perry (1970) and Kuhn et al. (2000) helped conceptualize the evolution of epistemological thinking from absolutist to relativist reasoning. However, subsequent research highlighted the limitations of these frameworks, emphasizing instead the multidimensional and context-dependent nature of epistemological understanding (Schommer, 1994).

Building on this shift, Hofer and Pintrich (1997) offered a more suitable framework for research teacher education since it integrates a multidimensional perspective, recognizing that EBs evolve through experience but are also shaped by situational contexts. This perspective identified four sub-dimensions that structure personal epistemology: (1) Certainty of knowledge, referring to whether knowledge is viewed as fixed or tentative; (2) Simplicity of knowledge, addressing whether knowledge is seen as a collection of discrete facts or as a network of interrelated concepts; (3) Source of knowledge, exploring whether knowledge originates from external authorities or is constructed through individual reasoning; and (4) Justification for knowing, which concerns how individuals evaluate evidence and decide what counts as legitimate knowledge. These dimensions together allow for identifying levels of epistemological sophistication, ranging from naïve beliefs that see knowledge as absolute to more sophisticated conceptions that acknowledge its evolving and contextual nature.

This framework offers a particularly strong foundation for understanding PSTs' EBs because it smoothly links beliefs about knowledge and knowing to learning and teaching contexts. By situating epistemological development within real educational experiences, it helps capture how PSTs negotiate between academic theory, professional practice, and personal reflection. Therefore, fostering sophisticated EBs might support teacher education's transformative purpose, as it encourages the development of professionals capable of navigating uncertainty, embracing multiple perspectives, and engaging in critical dialogue. Such progress aligns with broader educational goals of promoting critical thinking, democratic participation, and lifelong learning (Dyson et al., 2004; Hastie & Mesquita, 2016).

The Complex Journey of Becoming a Physical Education Teacher

Becoming a teacher is more than acquiring technical competence. It is a process of personal and epistemological transformation where PSTs evolve through cycles of consolidation and disruption rather than linear advancement. Within this trajectory, Occupational Socialization Theory (OST) offers a valuable timeframe for understanding how PSTs' beliefs and practices are formed and transformed throughout their journey. OST situates epistemological development within the broader socialization processes of teacher education, emphasizing how teachers' ways of knowing and teaching evolve across different stages of experience. Lawson's (1983a, 1983b) framework delineates three stages of socialization (acculturation, professional socialization, and organizational socialization) through which teachers' beliefs might reconfigure.

The acculturation phase reflects the influence of prior experiences as physical education (PE) students, coaches, or athletes. These experiences, referred to in OST as part of the acculturation phase (Lawson, 1983a, 1983b), shape deeply ingrained EBs long before teacher education begins. This acculturation process is not experienced uniformly across PSTs however, it can affect their willingness to embrace alternative or innovative pedagogical perspectives once they enter PETE (Moy et al., 2016). Many begin their PETE holding expectations grounded in authority and performance, which they often reproduce uncritically (Hammerness et al., 2005; Schempp & Graber, 1992).

Such preconceptions often mirror less sophisticated EBs, where knowledge is viewed as fixed and transmitted by experts. This orientation tends to promote directive, instructor-led teaching focused on the accurate reproduction of established content. In contrast, PSTs with more sophisticated epistemological understandings see knowledge as dynamic and context-dependent, emphasizing interaction, reflection, and collaboration in the learning process.

Considering EBs' implications for how PSTs perceive teaching and learning, it is expected that PETE opens opportunities for belief understanding and reconfiguration during the professional socialization phase. Indeed, it is during professional socialization that new pedagogical perspectives are introduced, and belief restructuring can occur, and PSTs experience new theoretical and practical frameworks (Curtner-Smith et al., 2008). This encounter does not immediately erase

earlier assumptions, but it introduces cognitive dissonance, prompting negotiation between old and new understandings (Moy et al., 2016). The professional journey thus becomes a dialogic process that fluctuates between resistance and transformation, where PSTs test, reflect, and reconstruct their EBs.

Research about this phase indicates that when PETE curriculum fosters supportive learning environments (e.g., student-centered approaches, reflexive dialogue) PSTs are more likely to develop increasingly sophisticated EB (Lodewyk, 2015, 2022; Hordvik and Beni, 2024). Within these contexts, they often begin to question fixed conceptions of knowledge and recognize learning as a participatory and relational process. Nevertheless, developing such epistemological sophistication depends not only on curricular exposure but also on institutional cultures.

Building on this, some PETE contexts involve real teaching experiences in a school setting, providing PSTs with a preliminary overview of the contextual pressures that may reinforce or challenge emerging epistemological orientations. Here, PSTs' move from PETEs' protective environment to the realities of institutional culture, assessment pressures, and classroom management where many face a "reality shock" (Banville and Rikard, 2009; Veenman, 1984). The interplay of these forces makes the development of EBs inherently non-linear, marked by progression, regression, and renewed reflection (Ristow et al., 2023).

This trajectory continues into the organizational socialization phase, when PSTs transition into professional practice as fully trained and independent teachers. Although equally relevant, this phase goes beyond the timeframe of initial teacher education and, as such, is not explored in depth in research on the development of EBs throughout PETE.

PETE Curriculum as the Starting Point for EBs Development

Historically, PE has been shaped by prescriptive, teacher-centered learning that prioritize skill reproduction, discipline, and behavioral control (Mosston & Ashworth, 2008). Contemporary educational paradigms, however, emphasize student-centered approaches (SCA), inclusion, participation, and critical engagement which aligns with broader aims to prepare autonomous, reflexive, and socially responsible

individuals capable of adapting to dynamic life circumstances (Gubacs-Collins, 2015; Silva et al., 2021).

Within this shifting landscape, PETE serves as a crucial site for socialization and epistemological transformation. As Lawson (1986) notes, PETE's curriculum operates as a socialization context, structuring interactions among PSTs, teacher educators, and peers, while shaping what forms of knowledge are legitimized or challenged. At the broadest level, it is possible to consider PETE curriculum functions as an architect of epistemological reconfiguration.

To achieve this, PETE programs need to provide experiences that encourage PSTs to confront and rethink deeply held beliefs often formed through years of acculturation in traditional PE environments (Stran & Curtner-Smith, 2009). This involves designing coherent programs where pedagogical strategies, teaching experiences, and supervisory practices discuss consistent and reinforcing messages about teaching and learning (Gurvitch et al., 2008; Baker, 2023). Such coherence enables PSTs to engage in reflexive discourse, participate in collaborative projects, and experience instructional approaches that embody constructivist principles.

Critically, SCA based curriculum in PETE is particularly relevant for fostering sophisticated EBs because it situates PSTs not merely as active participants, but as deliberate constructors of knowledge who engage in ongoing processes of meaning-making, interpretation, and critical reflection grounded in the program's experiences. Within SCA, learning is grounded in collaboration, autonomy, and problem-solving, fostering beliefs that knowledge is complex, evolving, and context-dependent (Dyson et al., 2004; Hastie & Mesquita, 2016). Such environments align with more sophisticated EB, where knowledge is viewed as interconnected and subject to interpretation and justification through critical reasoning (Hofer & Pintrich, 1997, 2002). By engaging PSTs in reflexive and inquiry-based practices, SCA-based PETE curricula encourage them to question prior assumptions developed during acculturation and to reconstruct their beliefs toward a more adaptive understanding of teaching and learning (Lodewyk, 2022).

Moreover, embedding SCA within PETE supports the dialectical process of professional socialization, allowing PSTs to negotiate between traditional perspectives and new constructivist paradigms. This process enables PSTs to recognize

teaching as an evolving, participatory act rather than a transmission of static knowledge (Lawson, 1983b; Butler, 2005). Through authentic learning experiences, SCA-based programs inherently promote epistemological growth, preparing PSTs to navigate and respond to the complexities of modern physical education with more sophisticated, adaptable, and critically informed EB (Gurvitch et al., 2008).

Within this curricular framework, specific pedagogical strategies can complement and support PETE's commitment to develop EBs. Strategies such as structured reflection and self-questioning encourage PSTs to confront their histories as learners. By articulating and scrutinizing their assumptions, PSTs engage in a form of autobiographical inquiry that challenges unexamined notions of teaching (Brownlee et al., 2001; Fletcher & Kosnik, 2016). Reflexive dialogue and guided questioning help PSTs move from certainty to inquiry, recognizing multiple ways of knowing (Azevedo et al., 2024).

Also, through other pedagogical strategies such as peer-teaching, micro-teaching, and collaborative learning tasks, PSTs learn in the ways they are expected to teach (Bransford et al., 2005). These experiences cultivate a constructivist stance where learning emerges from doing, observing, and collectively problem-solving (Howard et al., 2000; Tickle et al., 2005). Along with school placements, these spaces provide authentic, collaborative inquiry, facilitating belief refinement through negotiation and feedback.

With this foundation, a coherent rationale emerges. EBs determine how future teachers perceive knowledge, interact with students, and respond to the complexities of modern schooling. Here, PETE plays a pivotal role in orchestrating this reconfiguration through coherent curricula that integrate theory and practice, sustained mentorship, and carefully designed pedagogical strategies.

Issues concerning research on PSTs Epistemology

Over the past decades, scholars have examined how teachers' conceptions of knowledge and learning influence their instructional decisions (Hofer & Pintrich, 1997; Chan & Elliott, 2004; Kuhn & Weinstock, 2002). However, in the field of PETE, research specifically addressing EBs remains scarce, fragmented, and limited to the exploration of teachers' orientations through frameworks such as OST (Lawson,

1983a, 1983b; Stran & Curtner-Smith, 2009). While OST has clarified how beliefs are formed and reshaped across career phases, less attention has been paid to the epistemological nature of those beliefs and how PSTs conceptualize knowledge, its sources, and justification (Ristow et al., 2023).

Moreover, existing studies on this matter are predominantly cross-sectional and quantitative (Limón, 2016; Ristow et al., 2023), offering limited understanding of the processes through which these beliefs evolve. Such approaches often neglect the contextual, and temporal features of epistemological development that Hofer and Pintrich (1997) emphasize as essential. Consequently, there is insufficient evidence about how PETE curricula and pedagogical experiences influence PSTs' EBs.

Another notable gap concerns the pedagogical dimension of belief change. Much of the PE literature continues to emphasize teaching approaches (e.g., through models such as Teaching Games for Understanding, Cooperative Learning, or Sport Education), but rarely connects these to PSTs' underlying epistemology (Lodewyk, 2015, 2022). As PETE programs are expected to promote reflexive, student-centered, and context-responsive teachers, understanding how these pedagogies interact with PSTs' beliefs about knowledge becomes a critical issue.

Taken together, these opportunities point to a pressing need for longitudinal, qualitative research, particularly in form of case studies that consider good practices in PETE. Such studies could understand how PSTs' EBs develop, how pedagogical strategies shape this evolution, and how professional learning environments either foster or limit epistemological growth.

1.2. Research problems and aims

Research in teacher education have consistently demonstrated that EBs play a crucial role in shaping how teachers learn, interpret, and act in educational contexts. Indeed, teachers with more sophisticated EBs tend to foster critical thinking and student agency (Letina, 2022), while those holding more naïve beliefs often emphasize knowledge transmission and directive pedagogies (Otting et al., 2010). Consequently, the development of EBs has become an essential goal of teacher education, aligning with the shift from behaviorist to constructivist learning

paradigms that emphasize learner autonomy and inquiry (Bybee, 2010; Sengul et al., 2024).

Building on longstanding recognition of acculturation's influence on PSTs EBs, OST (Lawson, 1983a, 1983b) suggests that such beliefs take shape well before entry into PETE and can persist throughout professional socialization unless they are challenged. Despite this understanding, however, there is still little clarity on how EBs develop within PETE or how teacher education can impact their reconfiguration. This represents a missed opportunity, since PETE constitutes a critical period in which long-held EBs can be confronted, analyzed, and reconstructed through coherent curricular and pedagogical design (Gurvitch et al., 2008). It is theorized that when PETE curriculum, pedagogical modeling, and reflexive practice are aligned with constructivist views, PSTs are encouraged to view learning as an active, co-constructive process rather than a passive one (Linker & Woods, 2018; O'Sullivan, 2013). This alignment helps PSTs negotiate tensions between prior experiences and new conceptions, fostering more adaptive and responsive understandings of teaching and learning.

Indeed, despite theoretical recognition of the role of EBs in being lenses to learning and teaching, little is known about how PETE can systematically nurture their development toward sophistication. Understanding this process could clarify how PSTs navigate the interplay between inherited beliefs and new learning experiences, and how certain curricular designs and/or pedagogical strategies promote epistemological sophistication. In a rapidly evolving educational landscape, addressing this problem is essential as fostering sophisticated EBs is both an ethical and professional imperative.

In light of these considerations, the general aim of the study is to understand the impact of PETE on the development and reconfiguration of PSTs' EBs using a longitudinal case study. Furthermore, the study sought to gain an in-depth understanding of the intricacies PETE for the PSTs' epistemology. To guide the investigation, the following specific objectives were established:

1. To review existing knowledge on PSTs' domain-specific EBs, how do they have been theorized and measured and how they have been developing or changing during teacher education programs;

2. To understand the interplay of EBs, personal experiences and socialization processes, and the dynamics of PETE curricula to foster teachers' epistemological development;
3. To explore how acculturation-based EB manifestations emerge as PSTs enter the first year of an SCA-based PETE program;
4. To understand how PSTs' EBs develop through PSTs' professional socialization within the SCA-based curriculum, including the influence of pedagogical practices on their teaching preferences;
5. To follow the trajectory of PSTs' EBs as they progressed through a two-year PETE program, from the first curricular year to the school-placement year.
6. To interpret how the pedagogical strategies at each PETE stage may reconfigure the ongoing development and sophistication of PSTs' EBs;
7. To explore PSTs' experiences of school placement participation, specifically how engagement in CoPs mediates the influence of the PETE curriculum on their EBs.

1.3. Thesis structure

This dissertation follows the writing and formatting conventions of the Faculty of Sport, University of Porto (FADEUP), specifically aligning with the Scandinavian model. The selection of this structure stems from its widespread recognition, its capacity to foster discipline-specific competencies, and its relevance to academic inquiry. The journey of scientific publication from drafting and revision to peer evaluation and dissemination, has been crucial in cultivating critical reflection and broadening academic viewpoints.

The dissertation is organized into several chapters and academic articles, each playing a distinct role in expanding the overall aims of the project. This organization guarantees compliance with the publication standards of high-impact, peer-reviewed international journals. The dissertation comprises the following components:

Chapter I functions as the opening section, introducing the study and establishing its conceptual and theoretical underpinnings. It highlights both the relevance and originality of the research, offering a critical synthesis of existing

literature to situate the investigation within the broader academic context. In addition, this chapter defines the main purpose and specific research questions, while outlining the overall structure and organization of the thesis.

Chapter II provides a detailed examination of the dissertation's theoretical base, consisting of a systematic review of the literature and a theoretical essay. Their purpose is to connect and integrate pertinent theoretical models and frameworks, thereby constructing a cohesive and comprehensive overview of the field that supports the present research. The first theoretical article, titled "*Domain-specific epistemological beliefs' expression in initial teacher education: A systematic review*", seeks to understand how PSTs domain-specific EBs are studied and understood within initial teacher education with attention to theoretical, contextual, and methodological aspects. It focuses on identifying the most prominent theoretical frameworks and methodological strategies used in the research of EBs in teacher education contexts. Additionally, this article provides an analysis on the curricular and pedagogical interventions purposed to challenge epistemological understandings. Specifically, it synthesizes information about the contexts, designs and main findings of scientific studies in PSTs' domain-specific EBs from 2004 to 2024.

The second theoretical article, entitled "*A Theoretical Account of Epistemological Journeys in Teacher Education: The Physical Education perspective*", aims to explain the epistemological journey of PSTs and the role of PETE in it. It offers an integrative background linking EBs and OST to trace how PSTs' understandings of knowledge evolve from acculturation to professional socialization. The essay positions PETE as a critical context for cultivating adaptive, reflexive, and socially responsive teachers, capable of embracing complexity and uncertainty in educational practice. Implications for curriculum design and research are discussed, emphasizing the need for longitudinal, context-sensitive methodologies to capture belief transformation over time. The theoretical contributions of these two articles serve as a key pillar supporting the conceptual underpinnings of the empirical components of this thesis.

Chapter III presents the empirical portion of the thesis, comprising three qualitative studies. The first study, titled "*How Can a Student-Centered Curriculum Impact Preservice Teachers' Development of Epistemological Beliefs? A Physical Education Longitudinal Case Study*", focuses on exploring the impact of a

SCA-based curriculum on the development of PSTs' EB, during the first year of a PETE program.

The second study, "*Teaching to Believe Differently: Pedagogical Strategies and Preservice Teachers' Epistemological Development*", conducted within the PETE context over the course of two years. This research explains the role of PETE's pedagogical strategies on the PSTs' EB development and shows the non-linear process of EBs sophistication.

The third study, titled "*The promise and limits of communities of practice for preservice teachers' epistemological beliefs*", investigates how the PETE's school placement year, designed with the intention of fostering Communities of Practice (CoPs), may influence PSTs' EBs.

Chapter IV presents the final discussion, drawing together the theoretical perspectives explored throughout the thesis and substantiating them with the key outcomes obtained from each empirical article. This chapter summarizes and integrates the main findings, emphasizing their relevance, practical implications, and directions for future research.

References are listed at the end of each chapter, while the bibliographic details of each article are included at the end of the corresponding study, following the citation guidelines of the respective journals. For clarity and overall organization, Table 1 outlines the complete structure of the thesis.

Table 1. Overview of the structure, content, and studies included in this dissertation

Chapter I	Introduction
	Theoretical framework, relevance of the study, research questions and objectives, as well as the overall structure of the thesis
Chapter II	Theoretical Articles
Theoretical Essay	Barros, M., Mesquita, I., & Queirós, P. <i>A Theoretical Account of Epistemological Journeys in Teacher Education: The Physical Education perspective</i> https://doi.org/10.5628/rpcd.25.03.87 Published in Revista Portuguesa de Ciências do Desporto
Systematic Review	Barros, M., Mesquita, I., Bessa, C., & Queirós, P. <i>Domain-specific epistemological beliefs' expression in initial teacher education: A systematic review</i> https://doi.org/doi.org/10.20448/jeelr.v12i2.6754 Published in Journal of Education and E-Learning Research
Chapter III	Empirical Articles
Empirical Study 1	Barros, M., Mesquita, I., & Queirós, P. <i>How can a student-centered curriculum impact preservice teachers' development of epistemological beliefs? A physical education longitudinal case study.</i> https://doi.org/10.1123/jtpe.2024-0292 Published in Journal of Teaching in Physical Education.
Empirical Study 2	Barros, M., Mesquita, I., Valério, C., & Queirós, P. <i>The interplay between pedagogical strategies and preservice teachers' epistemological development</i> https://doi.org/10.1177/1356336X251413438 Published in European Physical Education Review
Empirical Study 3	Barros, M., Mesquita, I., Valério, C., & Queirós, P. <i>The promise and limits of communities of practice for preservice teachers' epistemological beliefs</i> Under Review in Curriculum Studies in Health and Physical Education
Chapter IV	Final Considerations
	Summary of the main findings, practical implications for PETE and recommendations for future research.

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Chapter II – Theoretical Articles

Theoretical Essay

A critical analysis about the interplay between epistemological beliefs' sophistication in teacher education and a physical education student-centered based curriculum

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Resumo

As crenças epistemológicas (CEs) influenciam expressivamente a forma como os professores interpretam e implementam os processos de ensino-aprendizagem. Na formação inicial de professores de educação física, a sua influência é ainda mais evidente, pois os futuros professores ingressam nos programas com crenças moldadas por experiências anteriores. Se não forem exploradas, estas crenças podem reforçar práticas tradicionais centradas no professor, dificultando a inovação pedagógica. À medida que os paradigmas educativos evoluem para a inclusão e o pensamento crítico, torna-se crucial compreender como as CEs se desenvolvem e preparar os professores para contextos complexos de ensino. Este ensaio analisa o desenvolvimento e a transformação das CEs na formação inicial, recorrendo à Teoria da Socialização Ocupacional e à epistemologia pessoal. Explora como as CEs são desafiadas e reconstruídas durante a formação inicial, e como as abordagens centradas no aluno podem promover a sua sofisticação. Em última análise, fomentar o desenvolvimento epistémico é fundamental para configurar a formação de professores num espaço onde os futuros professores podem envolver-se criticamente com o conhecimento, abraçar a incerteza e navegar pelos paradigmas educativos em evolução.

Palavras-chave: crenças epistemológicas; formação inicial de professores; socialização Profissional; currículos centrados no aluno

Abstract

Epistemological beliefs (EBs) significantly shape how teachers interpret and enact teaching and learning. In Physical Education Teacher Education (PETE), their influence is heightened, as preservice teachers (PSTs) arrive with beliefs molded by prior experiences. If left unexamined, these beliefs may reinforce traditional, teacher-centered practices, impeding innovation. As educational paradigms shift toward inclusion and critical thinking, understanding how EBs develop and preparing teachers for complex contexts has become crucial. This essay scans the development and transformation of EBs in PETE, drawing on Occupational Socialization Theory and personal epistemology. It explores how PSTs' EBs are challenged and

reconstructed during teacher education, and how student-centered and reflective approaches can foster epistemological sophistication. Ultimately, fostering epistemological development is key to transforming teacher education into a space where future teachers can critically engage with knowledge, embrace uncertainty, and navigate evolving educational paradigms.

Keywords: epistemological beliefs; initial teacher education; professional socialization; student-centered curriculum

Introduction

EBs are individuals' assumptions about the nature of knowledge and knowing, shaping how teachers and students engage with learning (Hofer & Bendixen, 2012). They form the cognitive foundations of teaching, influencing educational decision-making and instructional practice. Therefore, understanding EBs is crucial for grasping how individuals make sense of knowledge and classroom experiences, impacting teachers' professional growth.

Indeed, in educational settings, teachers' EBs profoundly shape their views of good teaching. Teachers with less sophisticated EBs often regard knowledge as fixed and transmitted by authority, favoring directive, content-driven approaches that prioritize performance and reproduction (Hammerness et al., 2005). In contrast, teachers holding more sophisticated EBs see knowledge as evolving, contextual, and co-constructed, aligning with reflective, student-centered pedagogies that promote inquiry and collaboration (Gholami & Husu, 2010; Hofer & Pintrich, 1997). Thus, EBs influence not only how teachers conceptualize teaching and learning but also how open they are to innovation and adaptability. Ultimately, EBs serve as the invisible framework through which pedagogical choices are interpreted and enacted (Lodewyk, 2015; Muis et al., 2006).

Within PETE, EBs gain relevance because PSTs enter these programs with beliefs deeply shaped by their long-term experiences as students, athletes, or coaches. These early experiences often reinforce traditional, teacher-centered conceptions of teaching that emphasize authority, performance, and reproduction of skills (Lawson, 1983a, 1983b; Lortie, 1975). Occupational Socialization Theory (OST) provides a useful framework to understand this process, explaining how

PSTs' beliefs are initially formed through acculturation and subsequently challenged or reinforced during professional socialization in PETE (Stran & Curtner-Smith, 2009).

During this journey, PETE represents a critical opportunity for epistemological reconfiguration. Through reflection, collaborative work, and real teaching experiences embedded in coherent, student-centered curricular framework, PETE can serve as a transformative space where PSTs reconsider inherited assumptions about knowledge, learning, and teaching (Dyson et al., 2004; Hordvik et al., 2019). By engaging PSTs in constructivist and dialogical learning environments, PETE programs can foster epistemological sophistication, helping them see knowledge as dynamic and knowing as co-constructed.

Building on these premises, this theoretical essay explores the nature and development of EBs in PETE, discussing how epistemological sophistication can be impacted through a student-centered curricular design and pedagogical practice. Drawing from theoretical developments in EB research and PETE literature, it also outlines implications for PETE programs and directions for future research to deepen the understanding of epistemological development in teacher education.

Epistemological Beliefs in PETE: A domain-specific lens

EBs are the assumptions and convictions that individuals hold about the nature of knowledge and how it can be acquired (Hofer & Bendixen, 2012) and given their intrinsic condition they act as filters to new understandings (Pajares, 1992). Therefore, they shape how future teachers interpret classroom experiences, choose content, manage student behavior, and define educational success. These beliefs are not fixed. Instead, they are dynamic frameworks that evolve with new Knowledge, filtering and reinterpreting its meaning (Zheng, 2009). Among belief systems examined in education contexts, EBs are particularly influential, as they form the foundation upon which other educational belief categories are constructed (Ristow et al., 2023).

The theoretical roots of EB trace back to early developmental research in education. Perry (1970) was among the first to approach EB from a developmental perspective. He proposed that individuals progress through stages of epistemolo-

gical understanding. Subsequent scholars, such as King and Kitchener (1994) and Kuhn et al. (2000), refined Perry's framework. Schommer (1990, 1994) introduced a multidimensional model of EBs, and Hofer and Pintrich (1997) advanced the concept of personal epistemology. Chinn et al. (2011) expanded Hofer and Pintrich's framework. Across these models, the characterization of EBs is usually done by considering their sophistication: individuals with less sophisticated epistemological beliefs perceive knowledge as absolute and certain, whereas those with more sophisticated beliefs view knowledge as evolving, contextual, and interconnected (Guilfoyle et al., 2020).

A notable characteristic of recent EBs frameworks is their emphasis on domain specificity. Rather than functioning as universal constructs, EBs often vary according to the subject area in which they are applied. Research suggests that disciplinary norms, methodologies, and epistemic practices shape how individuals conceive of knowledge and learning within specific fields (Hofer, 2001; Limón, 2006). Indeed, empirical evidence supports this view, demonstrating that EBs are strongly domain-dependent (Buehl & Alexander, 2005; Muis et al., 2006). This recognition has spurred growing interest in exploring EBs across diverse educational contexts and subject areas in recent decades (e.g., Bråten & Strømsø, 2004). Considering this, it is important for EB research to adopt theoretical frameworks that align with the domain-specific nature of beliefs and acknowledge their capacity to evolve and develop over time. Hofer and Pintrich's framework (1997) is particularly suited to understanding PSTs' EBs because it views personal epistemology as discipline-dependent, contextually activated, and shaped through practice, allowing for belief transformation when existing views are challenged.

Hofer and Pintrich's (1997) model organizes EBs into two overarching dimensions: beliefs about knowledge (the nature of knowledge) and beliefs about knowing (the process of knowing). Each dimension comprises two sub-dimensions. Within beliefs about knowledge, the clusters of certainty and simplicity describe whether individuals perceive knowledge as fixed or evolving, and whether they view it as composed of discrete facts or as an interconnected web of ideas. Less sophisticated beliefs regard knowledge as unchanging and singular in truth, while more sophisticated beliefs recognize its dynamic and provisional nature, responsive to context and new evidence. Similarly, simplicity ranges from perceiving knowledge

as isolated pieces of information to seeing it as a complex, interrelated system of concepts (Hofer & Pintrich, 1997, 2002).

The other dimension – beliefs about knowing – includes the clusters of source and justification of knowledge. The source sub-dimension concerns whether knowledge is believed to originate from external authorities or through personal interpretation and critical evaluation. Less sophisticated beliefs rely heavily on authority figures, whereas more sophisticated ones emphasize inquiry, reflection, and experience. Justification of knowledge refers to how individuals validate knowledge claims: simplistic approaches defer to experts, while more advanced reasoning involves synthesizing diverse perspectives and critically assessing evidence (Hofer & Pintrich, 1997, 2002).

As educational paradigms increasingly emphasize the development of personal and social skills, the importance of understanding EBs becomes even more evident. Within the physical education (PE) domain, the curriculum clearly reflects this emphasis by prioritizing empowerment, personal and social responsibility, self-confidence, and student engagement, which are among the most frequently highlighted aims of European PE programs (Opstoel et al., 2019).

When applied to teaching and learning contexts such as PETE, the level of sophistication within EBs has been closely linked to how teachers conceptualize and enact their teaching (Tanase & Wang, 2010). Teachers with less sophisticated EBs often view knowledge as fixed and transmitted by experts. From this perspective, learning is seen as the passive accumulation of facts, and effective teaching is equated with the accurate reproduction of established knowledge (Hofer & Pintrich, 1997, 2002; Lodewyk, 2022). Consequently, such teachers tend to prefer more traditional and directive methods where authority and control reside primarily with the instructor (Ristow et al., 2023). These pervasive beliefs can be resistant to change and, if unexamined, may undermine the goals of initial teacher education (Ennis, 1994).

In contrast, teachers with more sophisticated EBs perceive knowledge as evolving, contextual, and interconnected—both within PE and across domains. They understand that knowledge develops through interaction, collaboration, and engagement with multiple sources of information (Hofer & Pintrich, 1997, 2002; Lodewyk, 2015). This view aligns closely with the socio-constructivist foundations of

contemporary PE curricula, which position learning as a social, participatory, and meaning-making process. Considering, knowledge is co-constructed through dialogue, shared experiences, and reflection, emphasizing the dynamic interaction between teacher, learner, and context.

Despite substantial theoretical and empirical attention, research in this field is still marked by conceptual and methodological fragmentation and is often criticized for emphasizing inconsistencies rather than synthesizing knowledge (Bråten, 2010; Limón, 2006). In PETE (where EB research is still emerging) context-specific investigations may be essential for advancing the field rather than simply repeating past limitations. Given that EBs are complex, situated, and deeply personal, pursuing greater conceptual depth instead of premature systematization may offer more meaningful insights into how these beliefs form and shape educational practice.

An OST standpoint on EB development

Understanding how EBs take shape prior and during PETE provides valuable insight into how future teachers interpret their roles, approach teaching, and shape their teaching perspectives. While many factors influence this process, frameworks such as Occupational Socialization Theory (OST) help illuminate how prior experiences and professional contexts intertwine to shape these evolving belief systems within PETE (Curtner-Smith et al., 2008; Stran & Curtner-Smith, 2009). OST posits that teachers' beliefs are developed and reshaped across distinct phases of socialization – acculturation, professional socialization (PETE), and organizational socialization (Lawson, 1983a, 1983b). This theory provides a valuable framework for understanding how PSTs' experiences, both before and during teacher education, contribute to their perceptions and practices as teachers.

The acculturation phase occurs prior to PETE and is crucial in shaping PSTs' initial beliefs. During this stage, individuals accumulate experiences and perceptions of teaching, content, and instructional methods, often derived from their years as students, athletes, or coaches (Curtner-Smith et al., 2008; Lawson, 1983b; Lortie, 1975). In PE, this traditionally reflects prolonged exposure to teacher-centered

paradigms, emphasizing authority, repetition, and performance (Hammerness et al., 2005).

Research underpins that PSTs' early exposure to PE shapes their beliefs about what constitutes good teaching (Backes et al., 2021; Tsangaridou, 2006). Many have already internalized rigid ideas about the teacher's role, instructional strategies, and classroom management long before entering PETE (Pajares, 1992). Moreover, PSTs' beliefs about the purpose of PE frequently align with utilitarian goals such as improving physical fitness or promoting healthy lifestyles (Adamakis, 2018; Adamakis & Dania, 2020). This perspective often translates into practices dominated by repetitive motor tasks, leaving little room for creativity or critical engagement (Kulinna & Silverman, 2000; Stroot & Ko, 2006). In this context, learning is frequently understood as a one-way process of knowledge transmission (Sympas et al., 2017). Such beliefs reflect an epistemological stance that views knowledge as fixed and transmissible, a mindset strongly associated with direct instruction models (Lodewyk, 2015, 2022).

Following, the professional socialization phase represents the period in which PSTs participate in formal teacher education programs. During this phase, they experience an internal conflict between their pre-existing beliefs and the new ideas introduced through professional training (Schempp & Graber, 1992). This tension marks a crucial point for reflection and potential belief transformation (Zhang, 2022).

Despite the transformative potential of PETE, the literature suggests that its impact on changing PSTs' entrenched beliefs may be limited (Curtner-Smith et al., 2008). This is largely because traditional conceptions of instruction continue to dominate PE settings (Bessa et al., 2021). When entering PETE (professional socialization phase) empirical evidence shows that first-year PSTs tend to replicate these technique-driven approaches in their teaching, favoring repetition and teacher authority (Souza et al., 2017).

Yet, precisely because PSTs arrive with these deeply rooted assumptions, PETE becomes a critical and irreplaceable moment in shaping how they confront, question, and potentially revise their own beliefs. PSTs typically enter PETE confident in their knowledge and teaching abilities (Fives & Buehl, 2008), but they also show a notable openness to questioning established practices (Brock & Grady, 2007). As they learn about pedagogy and curriculum, they tend to be reflective and

willing to rethink their beliefs (Selley, 2013). Moreover, research has shown that some display a genuine willingness to experiment, question existing practices, and engage in innovative approaches to teaching (Butler, 2005; Barros, Mesquita & Queirós, 2025). Taken together, these characteristics position PETE as a decisive period capable of exerting significant influence on how PSTs reassess and reconstruct their epistemological and pedagogical assumptions.

This openness is essential, as beliefs are sensitive to the learning environment and can evolve when confronted with structured, reflective, and meaningful experiences (Muis et al., 2016). Therefore, PETE programs should design experiences that expose PSTs to diverse teaching models, encourage self-reflection, and cultivate adaptive thinking about knowledge and knowing, helping them view students as active constructors rather than passive recipients (Hastie & Mesquita, 2016). As Gurvitch et al. (2008) suggest, curriculum that promotes guided reflection, collaboration, and innovative pedagogies such as student-centered approaches (SCA), can help PSTs reassess and reframe their EBs, shifting from viewing knowledge as transmitted to co-constructed. Hence, PETE serves not only as professional training but also as a site for epistemological transformation, challenging deeply rooted assumptions shaped by acculturation.

A SCA-based PETE Curriculum as an Engine for Epistemological Sophistication

Historically, PE was shaped by directive, teacher-controlled forms of instruction, where learning was largely reproductive and students' roles were passive (Mosston & Ashworth, 2008). However, SCA have come to represent a part of a production style of teaching in contemporary PE, enhancing discussion on student's active role (Bessa et al., 2020). Today, these approaches reflect an educational shift toward environments where students participate actively in interpreting tasks, interacting with peers, and negotiating meaning within a shared learning process (Dyson et al., 2004), contributing toward more inclusive, reflective, and participatory learning environments (Gubacs-Collins, 2015; Silva et al., 2021). This orientation has been further operationalized through several student-centered models (such as Sport Education, Cooperative Learning, and game-based approaches) which promote

cooperative inquiry, shared responsibility, and multidimensional development across psychomotor, cognitive, social, and affective domains (Bessa et al., 2019; Silva et al., 2024).

In PETE, the move toward SCA is not simply a methodological preference but an epistemological repositioning. By situating PSTs within collaborative and inquiry-rich environments, SCA help counteract the influence of early socialization that often stems from earlier exposure to teacher-centered PE (Barros, Mesquita & Queirós, 2025). The epistemic gains extend further. As PSTs engage in student-centered learning, they develop the capacity to critically analyze their own beliefs (Lodewyk, 2022), engage in deeper reflection, and resist unexamined acculturation behaviors or superficial compliance with innovation (Schempp & Graber, 1992).

Crucially, the transformative potential of SCA is magnified when these principles form the core identity of PETE curricula rather than appearing as isolated modules or workshops. Research consistently shows that sporadic or short-term exposure produces limited change (Syrmpas et al., 2017), whereas coherent, sustained SCA experiences create a dialectical process through which PSTs can reorganize and deepen their EBs (Linker & Woods, 2018; Tsangaridou, 2006). Taken together, these insights highlight that the value of SCA lies not in occasional implementation but in the formation of a coherent, philosophically grounded PETE curriculum that positions student-centeredness as a structural feature rather than an instructional add-on.

Research tends to overlook how PSTs move through the full PETE cycle (learning about and enacting SCA). Experiencing SCA-based curriculum firsthand plays a meaningful role in how PSTs build their pedagogical and content knowledge, so PETE programs should purposefully engage PSTs in the planning, design, and implementation of a range of these approaches throughout their preparation (Valério et al., 2021). This requires aligning coursework, peer-teaching tasks, and school-based experiences in ways that minimize fragmentation and better equip PSTs for the complex and unpredictable realities of contemporary school environments.

PETE is frequently considered in its entirety, but its phases present unique features that call for individual consideration. Since PSTs experience the curriculum differently across PETE, each phase should be analyzed separately, with one phase taking place in the university-based curricular year where foundational understand-

ding and supported practice occur, and another taking place in the school-placement year where those understandings are enacted, adapted, and expanded in authentic teaching settings.

The curricular year: Conceptual foundation

As Bransford et al. (2005, p. 76) famously noted, “learning in the ways they are expected to teach may be the most powerful form of teacher education”. Therefore, when PSTs’ learning experiences are supported by environments specialized in SCA, they not only strengthen their theoretical understanding but also develop confidence and commitment to these pedagogies (Bessa et al., 2021; Brock & Grady, 2007).

Indeed, engaging PSTs with SCA during the curricular year of PETE supports them to confront their prior experiences while working with new ideas, creating space for meaningful belief restructuring. This involvement encourages them to question their assumptions rather than fall into passive routines that limit change (Lodewyk, 2022). Early opportunities to experience and lead SCA help PSTs see students as active learners (a key aspect of sophisticated EBs), while applying emerging pedagogical intentions in authentic settings (Lim and Chai, 2008; Gurvitch et al., 2008). In this environment of collaboration, autonomy, and shared responsibility, PSTs develop adaptive knowledge and navigate professional socialization with greater intention (Hastie and Mesquita, 2016).

Evidence shows that when PSTs engage in constructivist-driven curriculum reforms, their teaching tends to shift toward participation-rich and discovery-oriented practices (Lee et al., 2013). Rather than a linear progression, the move from beliefs to their enactment unfolds through repeated exposure to practice, opportunities for deliberate reflection, and access to meaningful guidance. These elements collectively create a space in which EBs can be reconsidered. Hordvik and Beni’s (2024) pedagogies of professional learning capture this process well, highlighting how placements and collaborative engagements prompt PSTs to rebuild their epistemologies within the realities of teaching.

Looking upon it, reflection appears as helpful for PSTs to evaluate and reconstruct their belief systems while strengthening the connection between beliefs

and pedagogical choices (Soleimani, 2020), whereas questioning techniques stimulate critical analysis and meaning making (Azevedo et al., 2024; Tsangaridou & Polemitou, 2015). In line with autobiographical pedagogies (Hordvik & Beni, 2024), such reflective processes encourage PSTs to examine their experiences, confront assumptions, and adopt more sophisticated epistemological positions (Shulman, 2005). Similarly, as emphasized by Azevedo et al. (2024), questioning strategies that stimulate critical thought can lead PSTs to adopt a more relativistic and flexible understanding of knowledge, moving away from rigid, absolutist perspectives.

Complementing these reflective dimension, hands-on strategies such as peer teaching and micro-teaching offer experiential contexts that foster reflexivity, collaboration, and critical thinking (Hordvik & Beni, 2024). Peer teaching is explicitly designed to challenge PSTs' beliefs and values about teaching and learning in PE and to encourage critical thinking and reflexivity (Hordvik & Beni, 2024). Similarly, micro-teaching allows PSTs to step into the teacher role, test strategies, and reflect on their effectiveness. As Tickle et al. (2005) observed, active engagement enables PSTs to internalize constructivist principles, while "living the curriculum" (Sinclair & Thornton, 2018) further enhances their capacity to experience pedagogical decision-making both as learners and as future educators.

The school placement year: Situated learning and professional communities

Research consistently shows that when theoretical coursework is meaningfully integrated with practicum placements, PSTs demonstrate significant improvements in instructional design, classroom management, and student engagement (Yilmaz, 2013). School placements thus represent essential contexts for epistemological and pedagogical growth. They compel PSTs to apply demanding pedagogical tools in authentic settings, fostering experimentation, innovation, and reflective problem-solving (Lamote & Engels, 2010). As PSTs confront discrepancies between their beliefs and their experiences during placements, they develop greater awareness of their assumptions and an openness to exploring new approaches (Palincsar, 1998).

Despite their potential, the structure of many PETE school placements remains “unfavorable”, especially because of short placement durations (Wahl-Alexander et al., 2017) and the pressure to quickly establish control over class behaviors for grading purposes (Hordvik et al., 2019) which often hinders meaningful pedagogical experimentation. In contrast, extended placements and longer learning units offer richer opportunities for development (Bodsworth & Goodyear, 2017). These experiences enable PSTs to progress from basic instructional scaffolding (e.g., peer/micro-teaching) to facilitating productive, student-led learning interactions (Glotova & Hastie, 2014).

When these experiences occur within supportive and collaborative environments, they can become even more powerful catalysts for belief transformation (Hordvik & Beni, 2024). To strengthen this collaborative learning during placements, PETE programs can integrate communities of practice (CoPs) as a framework for professional development. Empirical studies highlight the transformative potential of such communities by stating collaborative dialogue within professional networks show to enhance PSTs’ confidence and reflective capacity (Luguetti et al., 2019; Vetter, 2012). Hutchinson and Martin (1999) further demonstrated that sustained interaction and dialogue help bridge the gap between beliefs and practice, deepening professional learning. Within these communities, PSTs and the other members (e.g., school tutors, teacher educators) collaboratively discuss curriculum issues, analyze teaching challenges, and co-construct solutions, while faculty supervisors contribute through guidance and reflective questioning. In these CoPs, PSTs can also find a more interactive learning space that facilitates debate and supports the discussion of EBs through the lens of a SCA-based curricular essence, with SCAs serving as tools to help them further refine and sophisticate their EBs.

Indeed, participation in CoPs nurtures collaborative inquiry around teaching tensions and experiences (Vetter, 2012), cultivating greater professional confidence, reflective dispositions, and more nuanced perspectives on teaching. Such exchanges encourage PSTs to critically engage with their EBs and practices, leading to deeper learning and greater alignment between their beliefs and classroom actions (Hutchinson & Martin, 1999; Luguetti et al., 2019). Moreover, these collective learning structures provide essential social scaffolding for PSTs’ professional

integration, promoting shared knowledge construction and the development of new pedagogical skills (Valério et al., 2023).

Final Thoughts

PSTs' EB are powerful, persistent, and deeply informed by their own schooling and sports experiences. As this essay has argued, these EBs can pose significant barriers to teaching and learning innovation if left unexamined. Drawing from foundational work (Hofer & Pintrich, 1997; Lawson, 1983a), PETE must support belief reconfiguration not as a peripheral concern but as a central, strategic goal.

Implications for PETE practice and curriculum design

Belief change requires intentional curricular design, structured reflection, and coherent pedagogical experiences that challenge inherited assumptions (Bessa et al., 2021; Curtner-Smith et al., 2008). Integrating reflective, experiential, and socially embedded practices across coursework and placements makes PETE a space for both professional preparation and epistemological growth. To challenge PSTs' EBs, PETE must function as a holistic ecosystem throughout teacher education. Therefore, to promote the development of more sophisticated EBs, PETE programs should:

- Adopt coherent SCA-based curriculum: Embed socio-constructivist principles across all courses, ensuring that PSTs experience knowledge construction through collaboration and dialogue (Dyson et al., 2004) and replace fragmented or isolated pedagogical interventions with sustained coherence linking theory and practice (Linker & Woods, 2018).
- Cultivate reflective and critical engagement: Integrate guided reflection and autobiographical pedagogies to help PSTs examine their pre-existing beliefs, confront contradictions, and reconstruct more flexible understandings of knowledge (Azevedo et al., 2024).
- Provide experiential and collaborative learning contexts: Include micro-teaching, peer teaching, and extended school placements where PSTs can

apply and reflect on SCA strategies in authentic settings (Hordvik & Beni, 2024).

- Align mentorship and institutional vision: Promote a shared, philosophically grounded space across PETE that aligns curriculum design, reflective practice, and pedagogical experience (e.g., COPs).

Directions for future research

Given the complex and tacit nature of EBs, accessing them presents a significant methodological challenge (Lodewyk, 2015). The little research that exists on EBs in PETE has relied predominantly quantitative and cross-sectional designs, which limits the depth and nuance with which these beliefs are understood (Ristow et al., 2023). While such studies provide valuable data on trends and correlations, they rarely capture the complexity of belief formation, transformation, and resistance over time. This challenge can be addressed through research environments that stimulate deeper understandings, allowing for a more comprehensive exploration of PSTs' perspectives and development processes (Fives & Buehl, 2008). To achieve this, research designs must align closely with the epistemological constructs being investigated (Limón, 2006).

Within this context, the interpretative paradigm is particularly well-suited to this goal, as it supports approaches that uncover how PSTs make sense of their experiences and construct their belief systems. Here, qualitative designs fit especially well because they allow for an in-depth understanding of how EBs evolve (Adamakis, 2018). This will support the transition from descriptive studies to more intervention-based designs, capturing the implications of PETE in reshaping future teachers' EBs more effectively.

Case studies, action research, ethnographies, and similar designs offer valuable pathways for this purpose. Notably, a case-study approach can substantially advance EB research in PETE by enabling a focused and context-rich analysis of belief development within authentic program settings (Yin, 2018). Indeed, understanding examples of good practices within PETE, can uncover pedagogical interventions that effectively foster the progression toward more sophisticated EBs.

Identifying and disseminating such practices becomes essential for innovation in teacher education (Feucht et al., 2017).

Longitudinal proposals are also crucial, as they enable the identification and tracking of changes in EBs over time (Butler, 2005; Lodewyk, 2015). At the same time, methodological choices must remain sensitive to the specific research context to avoid overgeneralization and to support continued exploration of the structure and dynamics of EBs (Soleimani, 2020).

Finally, while most research has centered on PSTs, teacher educators and school supervisors also play a critical role in shaping epistemological development. Collaborative research that integrates the perspectives of all these actors can offer a more complete and nuanced understanding of how EBs are formed and transformed within initial teacher education contexts.

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Systematic Review

Domain-specific epistemological beliefs' expression in initial teacher education: A systematic review

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Abstract

This systematic review examines how preservice teachers' (PSTs) domain-specific epistemological beliefs (EB) are studied and understood within initial teacher education (ITE) with attention to theoretical, contextual, and methodological aspects. Findings from 24 empirical studies published up to 2024 were synthesized. The review analyzed theoretical frameworks, research designs, and tools commonly used to explore PSTs' EB across specific domains. Cross-study evaluations are challenging due to the ambiguity created by the lack of justification for framework selection, although the variety of theoretical lenses enhances the field. Similarly, methodological preferences such as the dominance of quantitative and cross-sectional studies using closed questionnaires offer generalizable insights but limit the depth of understanding regarding EB development. Nevertheless, specific contexts of ITE were identified as catalysts for developing EB, and some EB were seen as key predictors of student-centered teaching practices. The field shows theoretical and methodological fragmentation but offers insights into how ITE might influence EB. Bridging current gaps is crucial for a deeper understanding of PSTs' conceptions of knowledge and learning. Recommendations include adopting longitudinal designs, clarifying theoretical foundations, and involving broader ITE stakeholders such as mentors and policymakers whose beliefs also shape teacher education.

Keywords: Domain-specific, Epistemological beliefs, Initial teacher education, Preservice teachers, Professional learning, Review.

1. Introduction

Epistemological beliefs (EB) are people's presumptions and perceptions on the nature of knowledge and the process of acquiring it (Hofer & Bendixen, 2012). These beliefs relate to the definition of knowledge and how knowledge is constructed, evaluated, and developed (Hofer, 2001). EB plays a relevant role in educational sciences, specifically in shaping teachers' and students' interpretation and justification of knowledge and the overall learning process (Gholami & Husu, 2010).

The theories that conceptualize EB are rooted in constructs brought forth by seminal authors in the field of education. Perry's (1970) developmental perspective on EB served as the foundation for subsequent research and framework development in the field, specifically, developmental models of epistemology. These models describe how individuals' understanding of knowledge evolves. Kuhn, Cheney, and Weinstock (2000) propose four stages:

realist, absolutist, multiplist, and evaluativist highlighting the shift from objective to subjective knowledge coordination. Similarly, King and Kitchener (1994) outline three stages of reflective thinking, focusing on how individuals handle ill-structured problems.

A system of beliefs approach encompasses Schommer-Aikins's epistemological belief system within a multidimensional view (Schommer-Aikins, 2004). It presents epistemology as a collection of independent beliefs about knowledge and learning. These beliefs develop asynchronously and do not necessarily form a coherent system though mature beliefs support higher-order thinking. Buehl and Alexander (2001) argue that EB evolve from general to domain-specific knowledge and are influenced by academic experience and expertise based on the beliefs about the academic knowledge model.

Accordingly, personal epistemology models focus on how individuals construct knowledge and justify their beliefs. Hofer and Pintrich (1997) highlight the developmental nature of personal epistemology emphasizing its dependence on context and discipline. Meanwhile, the epistemological resources model (Hammer & Elby, 2002) sees knowledge as a set of flexible cognitive resources activated depending on the learning environment. Overall, these models collectively illustrate the complexity of epistemological development showing how beliefs evolve in response to different experiences and contexts.

EB dimensions are commonly classified within a spectrum ranging from absolute to evolving, simple to advanced or naïve to sophisticated understandings. Less developed positions tend to perceive truth as fixed and

unquestionable whereas more refined perspectives recognize knowledge as dynamic and context-dependent. (Schommer-Aikins, 2004). Such classifications provide a framework for understanding EB, its progression, and how individuals construct and refine their views on knowledge.

Another characteristic of EB is domain-specific (Buehl & Alexander, 2005; Muis, Bendixen, & Haerle, 2006). There has been a growing interest in this matter in the last decades (Sinatra & Kardash, 2004) showing that domain-specific norms and practices shape beliefs about the nature of knowledge and learning processes within subject areas (Hofer, 2001; Limon, 2006).

Nevertheless, research in this field is disputed and ambiguous due to various theoretical frameworks and methodologies (Limon, 2006). The existing works on the conceptual characteristics of EB focus more on critical opinions about inconsistencies in the research than on the already developed research systematization (Bråten, 2010; Limon, 2006). In the rare cases where analyses of the existing literature were conducted, these are centered on a single domain (Schiefer, Edelsbrunner, Bernholt, Kampa, & Nehring, 2022) despite providing relevant information, they do not present a sufficiently broad overview of the topic nor a sufficiently deep view on characteristics such as the theoretical frameworks or the methodological designs.

An essential perspective in which the literature still requires further impulse and development is that of preservice teachers (PSTs) (Brownlee, Purdie, & Boulton-Lewis, 2001). Initial teacher education (ITE) is a formative stage where PSTs interpret and engage with information. However, EB often inhibited ITE's value leading to teacher education programs that do not significantly impact PSTs' views on knowledge and knowing (Pajares, 1992).

As PSTs learn about pedagogy and curriculum, they are more likely to reflect on their beliefs and be more open to changing them (Selley, 2013). Hence, PSTs represent an optimal population for EB research as the ITE context enables researchers to observe the reconfigurations and their relationship with the development of their teaching understandings (Muis et al., 2006). Despite the relevant connection between EB and ITE, it is challenging to situate the multifaceted impact associated with them while also considering how these beliefs are uniquely tethered to the specific domains within the preparatory journey of PSTs.

1.1. Significance

This review delves into the granularity of a) theoretical frameworks – there are several, and they respond to different things, calling for a systematization of what has prevailed in theoretical mapping and its possible relationship with other factors. b) Domain specificity: the domains act as a context through which PSTs come to understand what counts as legitimate knowledge and the pathways to its acquisition. c) Methodological designs to understand how EB is being analyzed and what might be missing for a better understanding of the phenomenon. and d) EBs' relationship with ITE – what differences there are throughout the teacher education process and what influence curricula can have on this development. Such an analysis will offer insights and implications of the literature, contributing to a comprehensive understanding of the relevance of EB for both PSTs and ITE.

1.2. Research Questions

This systematic review aims to scrutinize what is known about PSTs EB in ITE and organize scientific data that is accessible within this context. The research questions that guided the review of these studies were as follows: (Q1) What is the theoretical framework used? (Q2) What domain (subject) is explored in the research? (Q3) Which methodological designs were used to access EB? (Q4) What EB do PSTs have during ITE? (Q5) What is the interplay between EB and ITE?

2. Methodology

The protocol used in this systematic review followed the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. This study was approved by the Research Ethics Committee of the first author's institution and followed the guidelines stated in the Declaration of Helsinki.

2.1. Eligibility Criteria

Following the Preferred Reporting Items for Systematic Reviews (Page et al., 2021) guidelines, eligibility criteria followed the PICOS approach: Participants-PSTs of any subject; interventions-related to PSTs EB; comparisons-EB at any given moment or throughout an initial teacher training program; outcomes – in reference to the EB theoretical framework, PSTs domain of study, EB development and methodological preferences; study design with a qualitative approach (including exploratory, emergent design, hybrid case study, self-study, case study, action research and visual methods), quantitative research and mixed-method research. Studies had to be empirical articles collecting primary data as we are interested in (a) epistemological beliefs, (b) PSTs, (c) published in peer-reviewed international journals, (d) available in full-text, and (e) written in English, Portuguese, or Spanish. Systematic reviews, conceptual articles and studies with experienced teachers were not included. No restrictions were applied to publication year, participants' age or gender.

2.2. Information Sources

Searches were performed on February 5th, 2025 in the following online databases: EBSCO, ERIC, Web of Science and SCOPUS. In addition to all the database papers published until the search date, external researchers (experts) were consulted to suggest articles that could integrate the systematic review.

2.3. Search Strategy

Boolean operators (AND /OR) were used and the title, abstract, or keywords were required to include ("epistemological beliefs", "personal epistemology", "epistemic beliefs" and "epistemic cognition") and ("preservice teacher", "student teacher", "teacher education", "apprentice teacher" and "practice teacher"). Additionally, each study's title, abstract, and reference list were manually searched to identify eligible studies not captured by the electronic searches.

An additional search was conducted by reviewing the reference lists of the included studies. Two researchers independently conducted the selection process

to reduce the risk of potential bias. Both researchers possess knowledge of this research methodology and EB. Any disagreements were resolved through mutual agreement.

2.4. Study Selection

The initial search of the databases was exported to reference manager software (EndNoteX9). Automated removal of duplicates was performed using EndNoteX9 but further manual removal of duplicates was required. Two researchers individually and independently evaluated the titles and abstracts of retrieved articles to assess their eligibility to be included in this article. The study abstracts that did not provide enough information according to the stabilized eligibility criteria were retrieved for full-text evaluation. In the second phase, articles were excluded if, based on the full text. a) There was no information on domain specificity. b) EB was not reported by domain. c) EB was not reported. d) Not focused on PSTs and d) domain-specific EB were reported but in a different subject to the one for which the PSTs were being prepared. In case of disagreement between the two authors, the differences were discussed until consensus was achieved.

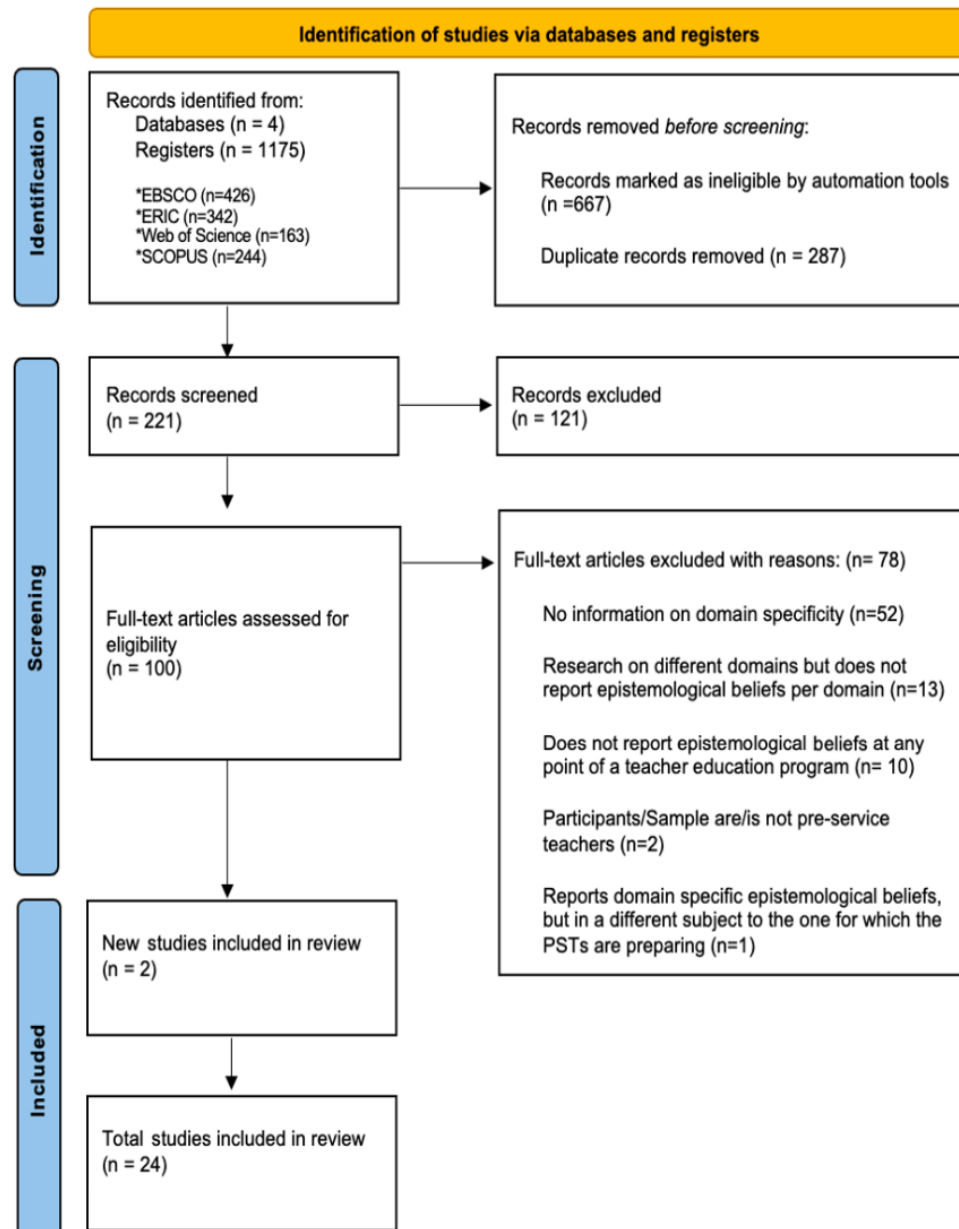


Figure 1. Study flowchart.

The initial research returned 1175 results (EBSCO: 426; ERIC:342; Web of Science: 163; SCOPUS: 244). After removing duplicates and according to inclusion criteria, 100 articles were listed as eligible for full-text screening. 78 articles were excluded for one or more reasons. Full-text screening of eligible articles revealed 22 papers identified for inclusion in the qualitative synthesis. Additionally, two more papers suggested by field experts were found to fulfil the eligibility criteria. A total of 24 papers were included in this systematic review. The PRISMA flow chart of the

study protocol is presented in Figure 1. It illustrates the various stages of the search process and the procedures employed for the study selection.

2.5. Quality Check and Rigor

The protocol for this systematic review was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on September 30th, 2022 Inplasy Protocol 3919. Moreover, the recommendations of the PRISMA statement were followed to improve the clarity, transparency, and quality of the systematic review.

Table 1. MAAT results: A critical assessment of methodological quality

Studies that meet all MAAT criteria			
Qualitative Studies	Quantitative non-randomized studies	Quantitative descriptive studies	Mixed methods studies
Guilfoyle et al. (2020) Guilfoyle et al. (2024) Kang (2008) Löfström and Pursiainen (2015)	Deniz (2011)	Atici (2023) Bayraktar (2019) Bejerano et al. (2023) Güven et al. (2014) Kırmızı and Irgatoğlu (2021) Sarıçoban and Kırmızı (2021) Şojat (2020) Yenice (2015)	Dinç and Üztemur (2017) Ozturk and Yilmaz-Tuzun (2017) Topcu (2013)
Studies that meet most MAAT criteria			
Qualitative Studies	Quantitative randomized controlled trials	Quantitative descriptive studies	
Markic and Eilks (2013)	Gill et al. (2004)	Choi and Kwon (2012) Kizkapan et al. (2024) Zorlu (2017)	
Studies that meet some MAAT criteria			
Mixed methods studies			
Cady and Rearden (2007) Huang-Yao and Shu-Ping (2010) Markic and Eilks (2012)			

The methodological quality of the studies was assessed using the Mixed Methods Appraisal Tool (MMAT) (Hong et al., 2018) which allows the evaluation of qualitative, quantitative, and mixed-methods studies. All studies included were assessed through MMAT version 2018. The category chosen to assess each paper was defined by its methodology. 21 papers appeared to meet the criteria of the

assessment tool, and three papers only met some of the criteria but MAAT discouraged their exclusion (see Table 1).

3. Findings

3.1. Overview of Studies' Features

Tables 2, 3, and 4 provide an alphabetical overview of the study characteristics included in the qualitative synthesis. Table 2 identifies each study's theoretical and demographic characteristics. Table 3 provides an overview of the key topics in each study. Additionally, Table 4 presents each study's aim, methodological design, and outcomes alphabetically to provide an organized overview.

Although there is no minimum time interval in this research, the oldest article is from 2004, and 15 papers are from the last ten years (2014-2024). These studies are geographically dispersed covering three continents with a greater incidence in Turkey (n=11).

Most articles (n=11) are grounded in Schommer's (1990) theoretical framework. There are also several references to Hofer and Pintrich (1997) and Perry (1970). Some articles include frameworks by Chinn and Malhotra (2011) and Markic and Eilks (2008) but the diversity seems limited overall. Additionally, one article has no defined theoretical framework.

In the compilation of selected articles, 4081 PSTs actively engaged as participants in the respective studies. The participants consisted of PSTs in different stages of their university degrees – grade level. It is important to note that ITE has different durations. For example, in Turkey, the ITE programs studied in these papers have a duration of 4 years. In Germany, the program lasts 5 years. This means that the category all covers different durations of ITE. The same applies to the final year category since it does not represent the same number of ITE years in all cases.

The studies analyzed reported different findings and provided an overview of each study's presentation (see Table 3). The synthesized findings from the reviewed studies are presented in the subsequent sections.

Table 2. Theoretical, geographical and demographical characteristics

Country relates to where the IT takes place. The theoretical framework relates to the theoretical lenses used to characterize EB. Domain is the subject/discipline of the ITE (e.g. science means an ITE preparing natural science teachers). Standing means the IT year PSTs were attending.

Author	Country	Framework	Domain	Standings
Atici (2023)	Turkey	Schommer (1990)	Physical Education	3 rd and 4 th
Bayraktar (2019)	Turkey	Schommer (1990)	Science	3 rd
Bejerano et al. (2023)	Not defined (Asia)	Celik et al. (2021)	Science	Not defined
Cady and Rearden (2007)	USA	Perry (1970)	Mathematics; Science	Final year
Choi and Kwon (2012)	Korea	Schommer (1990)	Mathematics	All
Deniz (2011)	USA	Hofer and Pintrich (1997)	Science	All
Dinç and Üztemur (2017)	Turkey	Schommer (1990)	Social Studies	All
Gill et al. (2004)	USA	Not Defined	Mathematics	1 st
Guilfoyle et al. (2020)	Ireland	Chinn et al. (2011)	Science	Final year
Guilfoyle et al. (2024)	Ireland	Chinn et al. (2011)	Science	Final year
Güven et al. (2014).	Turkey	Schommer (1990)	Science	2 nd
Huang-Yao and Shu-Ping (2010)	Taiwan	Schommer (1990)	Science	Not defined
Kang (2008)	USA	Perry (1970)	Science	Not defined
Kırmızı and Irgatoğlu (2021)	Turkey	Schommer (1990)	English	All
Kizkapan et al. (2024)	Turkey	Hofer and Pintrich (1997)	Science	2 nd , 3 rd and 4 th
Löfström and Pursiainen (2015)	Finland	Hofer and Pintrich (1997)	Mathematics	Not defined
Markic and Eilks (2012)	Germany	Markic and Eilks (2008)	Physics; Chemistry; Biology; Science	1 st
Markic and Eilks (2013)	Germany	Markic and Eilks (2008)	Chemistry	1 st , 3 rd and 5 th
Ozturk and Yilmaz-Tuzun (2017)	Turkey	Schommer (1990)	Science	All
Sarıçoban and Kırmızı (2021)	Turkey	Schommer (1990)	English	All
Šojat (2020)	Croatia	Markic and Eilks (2008)	Chemistry	1 st year
Topcu (2013)	Turkey	Hofer and Pintrich (1997)	Physics; Chemistry; Biology	Final year
Yenice (2015)	Turkey	Schommer (1990)	Science	All
Zorlu (2017)	Turkey	Schommer (1990)	Science	2 nd and 4 th

Table 3. Overview of the themes per study

Author	EB description	Grade Level Differences	Short-term courses/ Interventions	EB and Teaching Approach
Atici (2023)		x		
Bayraktar (2019)	x			
Bejerano et al. (2023)				x
Cady and Rearden (2007)			x	
Choi and Kwon (2012)		x		x
Deniz (2011)			x	
Dinç and Üztemur (2017)	x	x		x
Gill, et al. (2004)			x	
Guilfoyle et al. (2020)	x			
Guilfoyle et al. (2024)			x	
Güven et al. (2014)			x	
Huang-Yao and Shu-Ping (2010)			x	x
Kang (2008)			x	x
Kırmızı and Irgatoğlu (2021)		x		x
Kizkapan et al. (2024)	x			
Löfström and Pursiainen (2015)	x			
Markic and Eilks (2012)	x			x
Markic and Eilks (2013)	x	x		
Ozturk and Yilmaz-Tuzun (2017)				x
Sarıçoban and Kırmızı (2021)				x
Šojat (2020)	x			x
Topcu (2013)	x			
Yenice (2015)	x	x		
Zorlu (2017)				x

Table 4. Summary of data extraction from selected studies

Regarding the content table, the first column provides the "Author(s)", which presents the author(s) of the study and the publication year. The second column, "Main Objective" highlights the main research question of the study. The third column, "Main findings", provides the results overview.

Author	Main objective	Main findings
Atici (2023)	Examine the relationship between physical education PSTs' EB and academic self-efficacy	Physical education PSTs had high EB but low academic self-efficacy. There was a low negative relationship between grade level, EB, and academic self-efficacy.
Bayraktar (2019)	Explore PSTs scientific epistemological beliefs and attitudes toward science	PSTs had relatively developed EB; here were no significant differences between gender. It is suggested that the developed EB might result from ITE, but there is still room for improvement.
Bejerano et al. (2023)	Identify the EB held by science PSTs.	PSTs' EB, worldviews, and self-efficacy beliefs are interconnected, with self-efficacy and outcome expectancy being significant predictors of their EB about the "Innate Ability" factor. PSTs hold relatively simplistic bEB about "Certain Knowledge" and "Simple Knowledge", which are associated with their confidence in using student-centered teaching approaches.
Cady and Rearden (2007)	Identify PSTs EB and compare them between the two domains, within a course on SCA.	75% of PSTs had dualist views and expected the teacher to hold all content knowledge. Overall, PSTs have more traditional beliefs in mathematics than in sciences. EB are informed by previous experiences.
Choi and Kwon (2012)	Explore Korean PSTs EB about mathematics	Math PSTs held simple EB and objective and non-constructivist views towards mathematics. It is suggested that EB are influenced by cultural values.
Deniz (2011)	Examine PSTs EB in science and the factors that mediate those changes, within an intervention.	Conceptual change intervention was effective in improving PSTs EB views about science in all four dimensions; Thinking dispositions are related to EB development – higher thinking dispositions are associated with more sophisticated EB.
Dinç and Üztemur (2017)	Define PSTs EB about social studies	PSTs generally hold sophisticated EB about social studies. 4th year PSTs and female PSTs have more sophisticated EB than 1st year and males. Sophisticated EB are associated with democratic approaches preference.
Gill et al. (2004)	Investigate an instructional intervention to account for changes in PSTs EB.	The intervention, particularly refutational texts, provided EB development; Systematic processing does not mediate the relation between instruction and EB change.

Author	Main objective	Main findings
Guilfoyle et al. (2020)	Consider PSTs EB on the acceptance or rejection of "Education Studies" from their Initial Teacher Education.	EB salient features of PSTs' evaluation about Education Studies; PSTs recognize potential value of Education Studies for their practice, but something hinders further engagement.
Guilfoyle et al. (2024)	Explore how student research projects can promote the development of PSTs' EB.	Research experiences in ITE can contribute to the development of PSTs' EB though the extent and nature of the development varies. Additionally, research in science can lead PSTs to develop a more nuanced understanding of the tentative and interpretative nature of scientific knowledge.
Güven et al. (2014).	Examine how PSTs learning experiences and reflective diaries affect their EB.	EB dimensions improved except for certain knowledge (already sophisticated in the beginning); Reflective diaries may help PSTs to reconstruct their views and beliefs.
Huang-Yao and Shu-Ping (2010)	Investigate changes in PSTs EB within a collaborative knowledge building approach.	Engaging students in knowledge-building is helpful in shifting their pedagogical beliefs and EB to become more constructivist-oriented.
Kang (2008)	Identify possible connections among teaching goals, EB, and teaching actions during ITE.	PSTs EB and teaching goals influence their instructional choices. Some PSTs enacted more sophisticated EB than the ones they expressed, which means ITE provided opportunities for them to develop and translate EB into practice.
Kırmızı and Irgatoğlu (2021)	Investigate the relationship between PSTs EB and their approaches to teaching.	PSTs with more sophisticated EB are more likely to adopt SCA. Effort (EB dimension) predicts PSTs teaching approaches.
Kizkapan et al. (2024)	Examine the relationship between PSTs' understanding of the Nature of Science, EB, and pseudoscientific beliefs.	PSTs with more sophisticated EB also have more sophisticated views on the nature of science. There is no significant correlation between PSTs' EB, pseudoscientific beliefs, and nature of science views.
Löfström and Pursiainen (2015)	Understand PSTs EB and if EB might be a problem in pedagogical development.	PSTs relied on authority, as a justification for mathematical knowledge. PSTs viewed pedagogical knowledge as unrelated to practice; Engaging in research projects can help PSTs understandings on pedagogical knowledge.
Markic and Eilks (2012)	Describe PSTs EB within their respective teaching domain.	Physics and Chemistry PSTs hold traditional beliefs; Biology and Science PSTs hold more modern beliefs; Making EB explicit and fostering self-reflection in ITE could help PSTs to adopt SCA.

Author	Main objective	Main findings
Markic and Eilks (2013)	Investigate PSTs EB in different stages of ITE	PSTs hold traditional beliefs about teaching and learning in the beginning of ITE ; PSTs appear to have the most modern teaching beliefs midway through ITE. Senior PSTs tended toward more modern beliefs but not as strong and midway PSTs.
Ozturk and Yilmaz-Tuzun (2017)	Investigate the relationship between PSTs EB and informal reasoning	PSTs were found to possess no highly sophisticated EB; PSTs who have higher scores on innate ability, certain knowledge, and quick learning may have lower scores on their total argument construction.
Sarıçoban and Kırmızı (2021)	Observe potential correlations between PSTs EB, perceived engagement levels, and instructional preferences.	Effort dimension influenced instructional preferences; Teacher engagement has more connection with instructional preferences, than EB. PSTs favored constructivist instructional preferences.
Šojat (2020)	Investigate the initial PSTs EB.	90% of PSTs hold traditional EB , viewing learning as direct transmission of knowledge. It is suggested that PSTs EB are influenced by their experiences as students.
Topcu (2013)	Assess PSTs domain-specific EB.	EB about certainty of knowledge is less sophisticated in Physics; PSTs viewed authority and expertise as the source of knowledge more in physics and chemistry than in biology. The differences might be attributed to the inherent characteristics of each discipline.
Yenice (2015)	Identify the relationship between PSTs EB and their metacognitive perceptions about the nature of science.	PSTs had sophisticated EB about the nature of science and the process of knowledge construction; Gender had a significant effect, justified by epistemic maturity. Grade level had no significance, justified by the holistic development during ITE.
Zorlu (2017)	Investigate the relationship between PSTs EB about the nature of science and their science learning self-efficacy perceptions	95% of PSTs hold EB closer to the traditional understanding of science; Science Learning Self-Efficacy predicts and explain 23% of the EB scores.

3.2. Research Design Approaches

Most studies (13 out of 24) employed quantitative methods, utilizing statistical analyses and numerical data. Various survey instruments were employed to collect data, including the epistemological belief questionnaire (Schommer, 1990) – n=5; the epistemological belief survey (Chan, 2004) – n =3; and the discipline-focused

epistemological beliefs questionnaire (Hofer, 2000) – $n=3$. Two other studies relied on country-specific questionnaires, one of which was influenced by the work of Hofer and Pintrich (1997)

Additionally, five studies utilized a qualitative methodology. These studies have delved into the subjective experiences and individual reasoning underpinning PSTs epistemologies through in-depth interviews, reflective writing analysis, and participant observation.

The other six studies adopted a mixed-method approach. These varied methodological procedures, each with their respective affordances and limitations, play a critical role in deciphering the complexity of EB and often lay the groundwork for developing targeted educational interventions in ITE. These varied research designs provide a holistic view of the complexity of EB contributing to the development of educational interventions within ITE.

3.3. Characterizing Domain-Specific EB in ITE

The PSTs' EB varies across different subject domains, reflecting domain-specific orientations. Studies ($n=10$) on this research characterized the PSTs' EB in various domains, each with specificities.

In science education, research shows a range of EB among PSTs. Bayraktar (2019) found that science PSTs displayed more sophisticated beliefs in dimensions related to knowledge change, reasoning, and construction but less developed beliefs in terms of authority and the source of knowledge. Similarly, Yenice (2015) highlighted that science PSTs tended to hold sophisticated beliefs, emphasizing effort over innate ability and rejecting the notion of absolute truth. The relationship between EB and understanding of scientific disciplines was further examined by Kizkapan et al. (2024) who found that PSTs with more sophisticated EB also held more developed views on the nature of science. However, challenges in epistemological development were identified by Guilfoyle et al. (2020) who noted that PSTs often held "non-availing" EB that hindered their engagement with educational research. Moreover, perceptions of the epistemic similarities and differences between science and education studies impacted their evaluation of educational theories.

In social studies, Dinç and Üztemur (2017) found that PSTs exhibited relatively sophisticated EB across most dimensions. However, their beliefs about the structure of knowledge were only moderately sophisticated. Additionally, they perceived social studies as a subject closely connected to real life and regarded it as relatively easy to teach at the middle school level.

Mathematics PSTs demonstrated distinct domain-specific EB. According to Löfström and Pursiainen (2015) they tended to adopt a formalistic and performance-oriented approach to mathematics relying heavily on memorization and authoritative sources. Their primary focus was obtaining correct answers rather than engaging in deeper problem-solving and reasoning. In contrast, their views on pedagogy were more relativistic emphasizing subjective interpretations and intuition over theoretical foundations. This contrast between their EB in mathematics and pedagogy presented challenges in effectively integrating the two domains for teaching.

For physics, chemistry, and biology PSTs, research highlights disciplinary differences in EB. Topcu (2013) found that PSTs viewed knowledge in biology as more tentative and open to multiple interpretations. In contrast, knowledge in physics and chemistry was perceived as more certain, simple, and reliant on external authority. A similar pattern was observed by Markic and Eilks (2012) who reported that EB among PSTs ranged from objectivist, fact-based views to more constructivist orientations. Notably, physics PSTs tended to hold the most traditional beliefs, while biology PSTs demonstrated more modern perspectives on teaching and learning.

Studies focusing specifically on chemistry PSTs revealed contrasting trends. Markic and Eilks (2013) found that constructivist EB sees learning as an active and self-directed process. However, Sojat (2020) reported a predominantly traditional, teacher-centered approach among Croatian chemistry PSTs, with over 90% adhering to this perspective and only a small fraction adopting constructivist-oriented beliefs.

These findings illustrate the complexity of PSTs EB across disciplines. While some progress toward more sophisticated understandings of knowledge and learning, others retain traditional perspectives that may impact their teaching approaches.

3.4. Exploring the Link between ITE Grade Level and EB

Yenice (2015) found no significant differences in EB across grade levels, suggesting that EB remains stable throughout teacher education. In contrast, Markic and Eilks (2013); Dinç and Üztemur (2017) and Atici (2023) observed a developmental trend in which higher-grade PSTs demonstrated more sophisticated, complex, and dynamic EB, aligning with a shift towards constructivist perspectives. Markic and Eilks (2013) noted that PSTs move from teacher-centered to student-centered beliefs. Dinç and Üztemur (2017) found increased sophistication in the certainty of knowledge dimension. Atici (2023) indicated that fourth-year students had more developed beliefs than third-year students regarding learning by ability.

On the other hand, Choi and Kwon (2012) and Kirmizi and Irgatoglu (2021) presented the opposite perspective reporting a regressive trend where higher-grade PSTs held more objectivist, fixed, and authority-dependent beliefs. Choi and Kwon (2012) linked this shift to the test-driven Korean education system, while Kirmizi and Irgatoglu (2021) suggested that cultural factors contributed to first-year PSTs having more sophisticated beliefs than their senior counterparts. Thus, while some studies support an expected progression toward more complex EB, others highlight cultural and systemic influences that may hinder or even reverse this development.

3.5. Impact of Short-Term Courses and Interventions on EB Development

Kang (2008) and Güven et al. (2014) explored how practical experiences influence PSTs' EB. They found that field experiences provided opportunities for EB development with PSTs' teaching goals aligning with their beliefs, though contextual factors sometimes led them to revert to traditional methods. Similarly, hands-on science lab activities and reflective diaries (Güven et al., 2014) promoted EB development in all dimensions except "certain knowledge," showing a positive interaction between reflective diary scores and EB growth.

Similarly, Guilfoyle et al. (2024) also found that research experiences in ITE can contribute to the development of PSTs' EB although the extent and nature of this development might vary. Conducting research in science helps PSTs develop a more nuanced understanding of the tentative and interpretative nature of scientific

knowledge, while research in education studies allows them to gain a more complex understanding of researcher subjectivity and the limitations of educational research.

Further exploring reflection interventions, Deniz (2011) and Gill et al. (2004) focused on self-reflection as a mechanism for EB development. Deniz (2011) conceptual change intervention encouraged PSTs to discuss, access, and reflect on cognitive processes, significantly improving their EB across all dimensions. Thinking dispositions such as openness to alternative views were key in post-intervention outcomes. Similarly, the intervention used augmented activation and refutational text (Gill et al., 2004) to challenge and activate PSTs' existing beliefs, identifying effortful cognitive processing as essential for EB change, particularly in mathematics.

Huang-Yao and Shu-Ping (2010) and Cady and Rearden (2007) examined how collaborative experiences shape PSTs' EB. A web-based knowledge forum fostered collaborative discourse and constructivist beliefs (Huang-Yao & Shu-Ping, 2010). PSTs decreased their beliefs about the authority of experts and the certainty of knowledge and significantly reduced their beliefs about the traditional, teacher-centered conception of teaching. Similarly, Cady and Rearden's methods course, which emphasized student-centered approaches, helped PSTs develop more sophisticated EB, even though contradictions remained in their teaching practices – math PSTs leaned toward student-centered lessons despite holding teacher-as-authority beliefs, while science PSTs viewed their subject as interactive but still used teacher-centered methods.

3.6. Understanding the Connection between EB and Teaching Approaches

EB is deeply connected with PSTs' pedagogical choices, particularly in teaching approaches and instructional options. The findings across multiple studies (n=11) suggest that PSTs' views on the nature of knowledge and knowing significantly shape how they conceptualize teaching and learning, ultimately influencing their instructional decisions.

Bejerano et al. (2023) identified that PSTs' epistemological worldviews – realist, conceptualist, and relativist are directly linked to their teaching approaches. Realist teachers favor information transmission, conceptualist teachers encourage student

participation, and relativist teachers promote student autonomy. Furthermore, PSTs' beliefs about the certainty of knowledge are positively associated with their outcome expectations for students, while their beliefs about the simplicity of knowledge negatively correlate with their epistemological worldviews. Additionally, PSTs assume that student-centered teaching approaches will only be effective if their students also hold simplistic views about knowledge.

In the Croatian context, Sojat (2020) found that most chemistry PSTs maintain traditional, teacher-centered EB, reflected in their transmission-based instructional approaches. Similarly, Saricoban and Kirmizi (2021) observed that PSTs who believe in knowledge certainty, source, and learning ability tend to prefer transmission-based, teacher-centered instruction. However, these EB explain only 14% of the variance in instructional preferences, indicating the presence of other influential factors.

Ozturk and Yilmaz-Tuzun (2017) highlighted that PSTs with more sophisticated EB, acknowledging knowledge's tentative and complex nature are more likely to engage in effective reasoning and decision-making regarding socioscientific issues. Conversely, those with less sophisticated beliefs such as viewing knowledge as certain or easily acquired, struggle with the complexity of these issues and rely on intuitive reasoning. Kang (2008) reinforced this pattern showing that PSTs who perceive knowledge as evolving aim to cultivate students' scientific thinking and inquiry skills. In contrast, those who perceive knowledge as fixed emphasize transmitting factual knowledge. Similarly, Markic and Eilks (2012) noted that constructivist views of knowledge, recognizing its tentative and socially constructed nature align with student-centered teaching, whereas knowledge as a fixed set of facts corresponds to transmission-based instruction.

Kirmizi and Irgatoglu (2021) found that learning requires effort is positively correlated with student-focused teaching approaches whereas other dimensions, such as innate ability, authority, and certainty of knowledge did not significantly impact teaching approaches. Zorlu (2017) expanded this discussion by highlighting that EB's views on the nature of science influence their instructional approaches. Those with a positivist view tend to adopt traditional methods, while those embracing a constructivist perspective employ more student-centered techniques.

Huang-Yao and Shu-Ping (2010) emphasized that EB are closely tied to pedagogical beliefs. They propose that engaging PSTs in constructivist-oriented knowledge-building practices can shape their epistemological and pedagogical beliefs, ultimately impacting their classroom performance. Similarly, Dinç and Üztemur (2017) proved that teachers with sophisticated EB who recognize knowledge as complex and contextual are more likely to adopt student-centered and inquiry-based teaching methods. In contrast, teachers with naïve beliefs rely more on rote memorization and lecture-based strategies.

Lastly, Choi and Kwon (2012) explored the relationship between EB and their instructional approaches, demonstrating that their perspectives on mathematical knowledge and learning shape their teaching practices. This influences students' beliefs and academic performance underscoring the need for teachers to guide PSTs toward developing more constructive and adaptive teaching approaches.

These findings collectively affirm that EB is a foundational framework for shaping PSTs' teaching approaches.

The extent to which PSTs view knowledge as fixed or evolving, simple or complex, and certain or uncertain has profound implications for their instructional strategies, reinforcing the need for teacher education programs to foster sophisticated epistemological perspectives to support more effective teaching practices.

4. Discussion

This systematic review aimed to understand how PSTs EB is being studied and what is known about them during ITE. Accordingly, it raised divergent questions about the theoretical and methodological approaches and highlighted relevant themes for PSTs, such as enhancers of more sophisticated EB.

The temporal spectrum shows increased interest in studying PSTs' EB over the past ten years. The reformulations of ITE in various countries may justify this increase by seeking to understand EB in professional development contexts (Deniz, 2011; Sojat, 2020). There is a wide variety of frameworks. In most cases, there is no justification for the choice of why the framework is the best for the work being done. This raises questions about the importance of tailoring the theoretical

framework to the work's objectives. Since there is a variety of an EB framework, the pertinent selection of theoretical lenses is a key point that can bring even more clarity and scientific dimension to research results.

As the theoretical lenses for understanding EB differ among studies, the classification of dimensions cannot be discussed across the results. The myriads of theoretical frameworks employed across studies suggest a healthy diversity, but perhaps this fragmentation could benefit from greater convergence. According to Fives and Buehl (2008), only some empirical studies have explored teachers' EB using a clear and justified theoretical framework. This ambiguity may be responsible for the difficulty in understanding EB and its relevance to teacher training. However, present and previous studies' theoretical frameworks and methodological choices encompass the potential of more comprehensive approaches to EB in ITE and offer hope for the future of EB studies.

Methodologically, cross-sectional works, quantitative methodology and data collection through closed questionnaires with large samples were notable characteristics. The diversity of EB questionnaires, ease of application, and the ability to generate generalizable results justify this preference. The predominance of quantitative methodologies (13 out of 24 studies) using structured instruments such as the epistemological belief questionnaire (Schommer, 1990) and the epistemological belief survey (Chan, 2004) raises concerns about the depth of understanding these methods provide. While numerical insights are valuable, they may lack the nuance captured by qualitative and mixed-method approaches which offer a more holistic perspective on PSTs' belief evolution. EB are personal, profound and complex conceptions and trying to define them through a purely descriptive lens can be reductive. Just like with theoretical frameworks, research designs also need to align with the objectives of the work being developed. Without this coherence, the results may be difficult to interpret and inform ITE. Similarly, the rapid pace of change within educational contexts suggests that longitudinal perspectives on the evolution of EB may yield critical insights into teachers' professional development (Kang, 2008).

The findings revealed notable domain-specific variations in PSTs' EB, emphasizing the influence of disciplinary orientations. Studies indicated that science PSTs tend to develop sophisticated beliefs regarding knowledge construction and

change while mathematics PSTs often exhibit more rigid, performance-driven views relying on memorization and authority. Similarly, social studies PSTs demonstrate relatively sophisticated perspectives but may struggle to recognize knowledge structure complexity. These differences highlight the necessity for discipline-specific approaches when addressing EB in ITE. Recognizing these variations is essential for designing teacher education programs that support the development of more refined EB, ultimately influencing instructional practices and student learning outcomes.

Essential conclusions were reached regarding the behavior of EB at different grade levels. PSTs at higher grade levels would present more sophisticated EB but there were two contexts where this did not happen. The justifications are related to the solid Confucian influence in the Korean ITE (Choi & Kwon, 2012) and the adaptation to a new reform in the Turkish ITE. Conversely, other studies suggest a positive developmental trajectory, indicating that PSTs in the later years of their programs tend to embrace more constructivist views, moving away from teacher-centered epistemologies. This duality suggests that external cultural and systemic factors may play a significant role in shaping EB, necessitating a closer examination of how institutional contexts influence epistemological growth.

Beliefs are permeable and dynamic structures that act upon new knowledge and question their meaning (Zheng, 2009). Interventions such as field experiences (Kang, 2008), research participation (Guilfoyle et al., 2024) and reflection-based strategies (Deniz, 2011) have shown promising results in fostering more sophisticated EB. Studies highlight that guided reflection and engagement in inquiry-based learning can effectively challenge naïve beliefs and promote epistemic growth. This underscores the active role that ITE curriculums should play in helping PSTs discover new teaching methods and the importance of developing the ability to work and reflect within their professional settings.

These results agree with general research on EB indicating that introducing entrepreneurial activities for PSTs can help them reflect on their beliefs and practices, observe different teaching approaches, share experiences, and embrace an evolutionary approach leading to the collaborative development of beliefs and practices (Ertmer & Ottenbreit-Leftwich, 2010; Goksu & Demir, 2021). EB is sensitive to and influenced by the learning context (Muis et al., 2006) and that

sophisticated EB can be fostered directly through deliberated reflection and discussion of their referential and structural facets (Brownlee, 2004).

A key point in this analysis was understanding the suggested relationship between EB and teaching approaches and the implication that EB can predict the pedagogical choices of PSTs. For instance, PSTs' beliefs about the certainty and simplicity of knowledge significantly shape their instructional strategies, with more naïve beliefs leading to rigid, fact-based teaching approaches (Saricoban & Kirmizi, 2021; Sojat, 2020). Moreover, studies indicate that PSTs holding realist epistemological worldviews often favor direct instruction and information transmission, whereas those with constructivist perspectives tend to engage in student-centered, inquiry-driven practices (Bejerano et al., 2023). This relationship has been evidenced in other contexts beyond this review where people who believe that knowledge is evolutionary resort to more strategic thinking and interpret inconclusive content more accurately (Kardash & Howell, 2000).

Assuming this relationship exists, interest in developing more sophisticated EB should be enhanced for more democratic and engaging teaching pedagogies. This context should understand EB investigation as an opportunity to adapt and recreate ITE since these beliefs influence instructional preference and the acceptance of more student-centered approaches (Bahcivan, 2014).

4.1. Limitations and Implications for Future Research

Despite the thorough review, there are certain limitations to this study. Acknowledging these limitations can lead to a better understanding and maintain the review's integrity. As this review has extensively discussed, the diversity of methodological designs and theoretical frameworks creates ambiguity, contributing to the difficulty of generalizing results. Moreover, the variety of sociocultural characteristics, educational policies, and ITE standards is not just a limitation but a reminder to consider the context of each investigation to interpret these findings accurately.

Nevertheless, this paper synthesizes research on the EB of PSTs in various domains and highlights gaps for future research. First, clarifying the theoretical lenses that guide the work developed about EB is decisive. While various theoretical frameworks should be explored, explaining the theories behind the interpretation is important to clarify the analysis and results.

Second, it is crucial to reconsider which research methods contribute to a better understanding of ITE contexts. Therefore, future research needs to have a comprehensive understanding. Less descriptive and more intervention studies are needed to perceive the implications of ITE reconfiguring future teachers' EB. This can be achieved through case studies, action research, ethnographies, and longitudinal approaches. These efforts will help fill the gaps in our knowledge and improve the practicality of research findings, ultimately fostering the development of adaptable and thoughtful PSTs in the ever-changing field of ITE.

Considering the above recommendations, analyzing ITE curriculums and short-term courses might reveal the potential for educational interventions to facilitate the progression towards EB development. This literature synthesis enriches our understanding of how EB develops and paves the way for identifying practices that foster rich, informed and adaptive teaching practices.

Finally, while this literature research has primarily focused on PSTs, teacher and school tutors are also relevant to ITE. Therefore, collaborative research with these agents can deepen and refine the understanding of the development of EB.

5. Conclusion

The findings suggest that teacher education programs should include good practices and short-term courses focused on developing more sophisticated EB. The relationship between more sophisticated EB and student-centered approaches were grasped which is pertinent for further comprehension of the current panorama of teaching demands. Future research must adopt longitudinal designs underpinned by robust theoretical frameworks to address the research gaps and the factors driving EB development.

Understanding the nature of EB is paramount as it provides valuable insights into the intricacies of how PSTs perceive and acquire knowledge. It is possible to equip ITEs with the necessary tools to impact EB reconfiguration and make informed decisions to support their professional growth by gaining a deeper understanding of how PSTs conceptualize knowledge and learning (Erbaş, 2013). The gaps in our current understanding uncover new dimensions of epistemology that will enrich our collective knowledge and advance the field of education.

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Chapter III – Empirical Articles

Empirical Article 1

How Can a Student-Centered Curriculum Impact Preservice Teachers' Development of Epistemological Beliefs? A Physical Education Longitudinal Case Study

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Abstract

Purpose: This case study aims to understand the impact of a student-centered approaches (SCA) based curriculum on the development of preservice teachers' (PSTs) epistemological beliefs, during the first year of a physical education teacher education program. **Method:** The data were gathered during the first year of a physical education teacher education program through focus group interviews, reflective logs, and participant observations to access the experiences of 11 PSTs. **Results:** The shift to a more sophisticated epistemological beliefs emerged as PSTs acknowledged the adaptability and contextuality of knowledge, favoring SCAs. This change was shaped by integrating theory and practice, pedagogical approaches emphasizing SCAs, practical teaching experiences highlighting constraints and conflicts, and critical reflection. **Discussion/Conclusion:** This study offers insights for aligning teacher education curricula and practices to acknowledge epistemological beliefs and actively engage PSTs with SCAs toward building a democratic learning community.

Keywords: professional socialization, belief system development, teaching approaches, practical teaching experiences

Introduction

For more than five decades, researchers have devoted their efforts to gaining insight into epistemological beliefs (EB) within the field of education (Merk et al., 2018). EB are individuals' assumptions and convictions about the nature of knowledge and how it can be acquired (Hofer & Bendixen, 2012). They are also domain-specific and context-dependent and can be understood as one's understanding of the sophistication of knowledge and knowing (Hofer & Pintrich, 1997).

Literature on preservice teachers' (PSTs) beliefs has pointed out that deeply held beliefs can shape how they engage with learning to teach and the knowledge they build through that process, increasing academic interest in this career stage (Fives & Buehl, 2008). Studies within the physical education (PE) domain have often explored beliefs through the lenses of occupational socialization theory (OST;

Curtner-Smith et al., 2008; Stran & Curtner-Smith, 2009). This theory underpins that beliefs are formed and developed in different stages, often defined as acculturation, professional socialization, and organizational socialization, respectively (Lawson, 1983a, 1983b).

PSTs often enter PE teacher education (PETE) with predeveloped beliefs about teaching that were established pre-PETE (the acculturation phase) from their past experiences as students, athletes, coaches, and sports monitors (Butler, 2005; Schempp & Graber, 1992). Some studies highlight that during this phase, beliefs are often related to processes of passive and unilateral transmission of knowledge from the teachers to students (Hammerness et al., 2005). Consequently, these experiences are projected into PETE (professional socialization) and may result in PSTs viewing themselves and acting as passive recipients. Nonetheless, PSTs are also seen as agents of innovation, motivated to experiment and consider new ideas (Butler, 2005), which underlines an opportunity for PETE programs to engage in supported initiatives for EB development.

Throughout the 20th century, PE was dominated by a prescriptive and formal style of teaching (i.e., reproduction teaching), where knowledge was conveyed by a teacher, tasks were organized and defined in time, and students were mere reproducers (Mosston & Ashworth, 2008). Yet, while student-centered approaches (SCA) are often seen as a modern paradigm, their roots can be traced as far back as Dewey's work (1896). Indeed, the British movement education approach of the late 1960s and early 1970s can be considered student-centered, with learning advancing through cognitive, psychomotor, and affective education (Logsdon et al., 1984). Likewise, Bunker and Thorpe's (1982) Teaching Games for Understanding (TGfU) engaged learners in decision making, fostering both game awareness and physical skill development. Discussions about more engaging lessons, where the students play an active role, have however remained prevalent to ongoing social calls for education (Bessa et al., 2020). In this context, SCA have emerged as part of a production style of teaching, responding to the educational demands, with individuals integrated into a collaborative learning process (Dyson et al., 2004).

Therefore, considering the impact of occupational socialization on PSTs (e.g., possibly derived from their teacher's connection with the older paradigms), PETE should provide conditions to develop beliefs through adaptative knowledge in the

active role of the student, focusing on professional socialization processes by creating learning opportunities for collaboration with peers and to develop autonomy and responsibility (Hastie & Mesquita, 2016). Here, we argue that by focusing on SCA in PETE, professional socialization could become a dialectical process where PSTs negotiate between their prior experiences and new knowledge, possibly resulting in belief restructuring. Additionally, a SCA – based curriculum in PETE can stimulate PSTs' analysis of beliefs (Lodewyk, 2022) and foster deeper reflection, counteracting the adoption of studentship processes and resistance to change (Schempp & Graber, 1992). Since constructivist teaching approaches (where SCA are clustered) promote beliefs on students' active role in their learning – more sophisticated EB (Lim & Chai, 2008) – they can support PSTs in engaging with the complexities of professional socialization rather than simply aiming to navigate this phase with greater ease (Graber, 1991).

Despite recent advances in research that considers the ways of thinking in PE (Flemons et al., 2018; Quennerstedt, 2013), to the best of our knowledge, there are no empirical studies on the curricula and characteristics of PETE to enhance the development of EB in PSTs. Research on EB in PE is mainly supported by quantitative and cross-sectional data, making it difficult to comprehensively understand unresolved issues (Ristow et al., 2023). Hence, employing a case study approach holds particular significance in advancing research on EB within PETE, as it facilitates a rich and specific setting analysis (Yin, 2018). Moreover, a longitudinal case study can add meaning to defining knowledge and drawing implications for practice, which is essential for addressing the current void in the literature.

EB Conceptualization

EB is the most prominent and descriptive term for beliefs about knowledge and knowing (Hofer & Pintrich, 1997; Schommer, 1990). Several theoretical interpretations of EB were developed, the most relevant being general development approaches (King & Kitchener, 1994; Kuhn et al., 2000; Perry, 1970) and multidimensional systems (Hofer & Pintrich, 1997; Schommer, 1990). General development approaches do not consider different dimensions of EB, while multidimensional

systems, as the name implies, consider EB in different subdimensions. However, only Hofer and Pintrich's (1997) framework considers EB context and domain dependent. Therefore, in research with and about PSTs, this approach is deemed more appropriate to understand EB as it considers that personal epistemology is discipline-dependent (e.g., PE), situated in practice, and activated by context (e.g., teacher education).

Hofer and Pintrich's (1997) theoretical conception is organized into two dimensions: EB about knowledge (nature of knowledge) and EB about knowing (how knowledge is acquired). The first dimension encompasses the clusters of certainty and simplicity of knowledge, while the second dimension includes the clusters of source and justification of knowledge. Within the EB about knowledge subdimensions, certainty relates to views on how evolving knowledge is. Less sophisticated beliefs consider knowledge as unchanging, implying there is a single truth. More sophisticated beliefs, however, view knowledge as fluid and evolving, shaped by context and new evidence. Complimentarily, simplicity indicates whether knowledge is seen as an accumulation of isolated facts (less sophisticated) or understood as an interconnected network of ideas and concepts (more sophisticated). Among EB about knowing subdimension, source of knowledge addresses one's belief about whether knowledge is derived from authority (less sophisticated) or personal experiences and critical evaluation (more sophisticated). Lastly, justification for knowledge relates to how someone validates knowledge. A less sophisticated perspective might rely solely on deference to experts, while a more sophisticated belief involves reflective judgment, considering and synthesizing multiple sources of information critically (Hofer & Pintrich, 1997, 2002).

When considering teaching and learning environments, EB's level of sophistication has been highlighted as having a close relationship with teaching approaches (Tanase & Wang, 2010). More specifically, PSTs who hold less sophisticated EB tend to believe that knowledge is maladaptive, unchanging, made of the accumulation of facts, and transmitted and exposed by an expert (Hofer & Pintrich, 1997, 2002; Lodewyk, 2022). Through this belief system, PSTs tend to prefer more direct methods of instruction, where success is linked to the reproduction of knowledge (Ristow et al., 2023).

On the other hand, PSTs with more sophisticated EB agree that knowledge is evolving, adaptable, connected within PE and to other subjects, and is constructed individually and in collaboration through various reliable sources (Hofer & Pintrich 1997, 2002; Lodewyk, 2015). Indeed, based on these more sophisticated beliefs, PSTs show a preference for holistic student development through pedagogies that are less directive (Cothran & Kulinna, 2006) and more centered on incorporating teaching strategies to encourage students to take an active role in their learning (Letina, 2022). Pedagogical preferences related to more sophisticated EB are aligned with the characteristics of SCA. Indeed, in SCA, teachers act as facilitators, guiding students to take an active role in their learning by fostering autonomous, responsible, and competent behavior; encouraging collaboration and problem-solving within diverse groups; and promoting lifelong learning through meaningful experiences (Dyson et al., 2004; Hastie & Mesquita, 2016).

OST in EB Development

Although we can argue that more sophisticated EB and preferences for SCA are the desired development throughout PETE, socialization processes can present a constraining impact (Moy et al., 2016). The OST aims to understand how socialization influences individuals' entry into PE and shapes their perceptions and actions as teachers, focusing on their evolving theoretical and practical perspectives (Lawson, 1986). It can serve as a theoretical timeline that describes when beliefs are formed and reconfigured throughout their professional journey (Lawson, 1983a, 1983b; Stran & Curtner-Smith, 2009).

First, the acculturation phase emerges as a stage where PSTs develop their initial EB and acknowledge pedagogical preferences and motivations based on their previous experiences (Lawson, 1983b; Curtner-Smith et al., 2008). This socialization phase is not the same for all PSTs, but it can condition the open-mindedness needed during PETE to consider innovative teaching approaches different from those they expect at entry (Moy et al., 2016), often focused on teacher-centered approaches. Consequently, during the process of professional socialization in PETE, the previously acquired EB can resist possible reconfiguration (Lawson, 1983b).

Nonetheless, some PETE curriculum characteristics, such as SCA-centered curricula (Gurvitch et al., 2008), might impact the reorientation of PSTs' EB. By understanding the relationship between SCA and EB (Lodewyk, 2022), PETE will consequently be an enabler of the epistemological reconfiguration of PSTs. Therefore, PETE programs should be framed within reflective, critical, and SCA teaching practices aimed at nurturing active participation in the reconfiguration of PE teaching (Valério et al., 2023). In this PETE, the explicit goal is not EB development but its SCA-based curriculum inherently fosters conditions that may contribute to EB reconfiguration toward sophistication.

Although we understand that both professional and organizational socialization (the stage of officially being a PE teacher) are spaces for professional adaptation, this study aims to focus on the particular transition from less to more sophisticated EB and the possibilities for professional socialization during PETE. Thus, the primary purpose of this case study was to understand the impact of a SCA-based curriculum on the development of PSTs' EB during the first year of a PETE program, particularly, on three folds: (a) What is the initial manifestation of the PSTs' EB? (b) How do SCA understandings contribute to the EB sophistication? (c) What implications does pedagogical practice have for PSTs' EB and teaching preferences?

Methodology

Study Context

This case study focuses on the Master of Physical Education Teaching in Basic and Secondary Education, which corresponds to the stage of professional socialization. This PETE at the Faculty of Sports, University of Porto ranks highly in world university rankings by subject, reflecting the program's quality and underscoring the university's innovative curriculum design. The 2-year program admits PSTs who have already completed a sports science degree, granting them the diploma and the official recognition required to pursue careers as PE teachers, when completed. In this case, in addition to the 12 years as PE students, the acculturation phase included 3 years as sports graduates without any teaching specialization.

During the PETE first year, the curriculum covered a range of curricular units with a strong complementarity, which privileges the theory–practice nexus in the

pedagogical field, specifically about SCA's exploration, reflection, and experimentation (Table 1). First semester modules span 5 months, prioritizing research, reflection, group work, flipped classrooms, debates, and cooperative activities in authentic environments that fostered critical thinking and PSTs' active participation. Notably, in the teaching methods and sport-specific course units, SCA has theoretical, practical, and experimental scaffolding. In the first semester, teaching method module (5 months long) provides a space for PSTs to develop versatile knowledge about broad approaches such as cooperative learning (Dyson & Casey, 2016) and the Sport Education Model (Siedentop, 1994), as well as team sports-specific methods like TGfU (Bunker & Thorpe, 1982), the Step-Game Approach (Mesquita et al., 2005), and Invasion Games Competence Model (IGCM; Musch et al., 2002). Pedagogical tools focus on fostering cognitive engagement and include strategies such as scaffolding responsibility and autonomy, demonstration, questioning, feedback, and recognizing the teacher's role as a facilitator.

In the second semester, the sport-specific course units immerses PSTs in 5-month peer-teaching and microteaching modules blending academic and real school contexts. Peer-teaching modules enable PSTs to apply SCA knowledge in controlled settings, free from real-world constraints (disciplinary, material, and climatic). Practical sessions focus on implementing Sport Education Model in athletics, IGCM in football, Step-Game Approach in volleyball, and hybrid models in Dance and Combat Sports, with PSTs engaging as students and teachers. Modules of microteaching in real school contexts begin in faculty settings for preparation and organization, followed by practical sessions in schools. PSTs face real teaching challenges, adapting class plans to constraints like students' behavior and resources. They engage with TGfU in handball, IGCM in basketball, and other models involving SCA characteristics in swimming and gymnastics.

Throughout these experiences, the inherent characteristics of this PETE invite PSTs to experience PE dynamics through cooperative environments, assume the facilitator role while exploring SCA, and scaffold the level of autonomy and responsibility granted to students without compromising their learning outcomes. Consequently, PSTs are invited to reflect upon internal conflicts due to confrontation with new knowledge throughout PETE. This SCA-based curriculum might guide the

development of EB toward greater sophistication, even though this PETE does not explicitly aim to transform the PSTs' EB.

Table 1. Pedagogical Contents and Activities From PETEs' Curricular Units (First Year)

Curricular Units	Pedagogical contents and activities
Pedagogical Professionalism PE Curricular Development Education Research School Culture and Organization Education Psychology Sports Practical Studies	• Fostering research habits, reflection, and ongoing participation in the content; • Group work for presentation and discussion throughout classes; • Engaging in cooperative work in small groups; • Employing flipped classroom techniques; • Critical reflections, debates, and group work; • Employing questioning, argumentation, and debate in class.
Teaching Methods Course	• Extensive exploration of different SCAs; • Stimulating learning context for cognitive engagement; • Scaffold responsibility and autonomy in learning; • Exploring the use of demonstration, questioning, and feedback. • Recognition of tools for transitioning from the teacher as authority to the facilitator.
Sports Specific Teaching Course (peer-teaching) Athletics; Volleyball; Football; Combat Sports; Dance.	• Practical contact with Sport Education Model (SEM) (athletics), the Invasion Games Competence Model (IGCM) (Football), and the Step-Game Approach (SGA) (Volleyball); • Experience with different models both as students and as teachers; • Possibility to experience SCA in controlled contexts; • Planning, organizing, and evaluating in the practical context of PE; • Reflecting on experiences in brief meetings, groups, and individually.
Sports Specific Teaching Course (micro-teaching in real school context) Basketball; Handball; Swimming; Gymnastics.	• Confrontation with the difficulties of the real teaching context; • Solving and adapting class planning to the real constraints of practice; • Practical contact with Teaching Games for Understanding (TGfU) (handball), IGCM (Basketball), and hybrid models involving SCA characteristics; • Keep the focus on teaching and learning activities while scaffolding student autonomy; • Reflecting on experiences in brief meetings, groups, and individually.

Participants

The participants were PSTs enrolled in the first year of the PETE program as full-time PE student-teachers. PSTs were chosen based on availability and willingness to participate, using purposive sampling to consider PSTs sports' background and gender. A sociodemographic questionnaire was used to characterize PSTs, with approximately 45 of the 120 first-year master's students responding, resulting in the final 11 participants. Their ages ranged from 20 to 38 years, all having backgrounds in sports-related roles such as coaching, fitness training, refereeing, or instructing at summer camps. Efforts were made to achieve a gender balance, resulting in six males and five females; while participants could choose from female, male, and other, only the first two options were selected. This variety was important because the participants had gone through different stages of acculturation and, as such, could represent EB developed in different contexts.

Given this study's interpretative paradigm, the first author's (FA) position and contribution are a valuable resource upon which to be drawn. The FA was a teacher education researcher and a PhD student in Sports Science who graduated from the same PETE program. This meant that the FA was aware of the professional socialization process, which made it easier to navigate the various data collection moments and focus on the research objectives. Nevertheless, as subjectivity should be consciously used, there was a constant dialogue with the research team to avoid bias (Patton, 2015). The study was approved by the Ethics Committee of the Faculty of Sports, University of Porto. All participants signed the informed consent form, and fictitious names were assigned to safeguard their privacy.

Data Collection

The data collection process for the study was structured across four distinct stages. Initially, a focus group (FG) was conducted at the beginning (FG1) of the PETE and to support the identification of critical questions. At the end of the first semester, data from the reflective log (RL) 1, focusing on the PSTs' Pedagogical Professionalism curricular unit task, along with the second FG (FG2), were collected. During the second semester, observations of microteaching in a real school context were conducted alongside RL 2 related to sport-specific course units.

Finally, the third FG (FG3) was carried out at the end of the first year. The longitudinal approach across one school year connected with these data sources endorsed a deep understanding of the PSTs' development, focusing on their voices and expressed beliefs.

FG Interviews

The three FG sessions covered PETE's early, mid, and late stages and were conducted in groups of three or four participants, resulting in a total of nine FG interviews lasting approximately 110 min. FGs were conducted in faculty settings, and each session was audio-recorded, transcribed verbatim, and validated by the participants to preserve the integrity of the data. The FA conducted the semistructured FG with three primary objectives: first, to encourage dialogue concerning fundamental concepts regarding PE teaching; second, to delve into the perceptions and insights of PSTs regarding their development as teachers; and third, to foster honest and open discussions, promoting self-reflection and active participant voice.

The script of FG1 was structured based on the research objectives and other relevant EB development work using the Hofer and Pintrich (1997) framework. In addition, we incorporated some questions from Fives and Buehl (2008) study that were adapted to fit our specific context and goals, allowing us to access the nature of EB, its development during PETE, and its connection with SCA. For example, questions such as "What do you believe is the purpose of schools?" (Fives & Buehl, 2008, p. 173) were changed to "What do you believe is the purpose of physical education?" The first FG aimed to understand the initial EB (e.g., What is the role of the PE teacher? How do PE students learn? What is taught in PE?). The remaining two (FG2 and FG3) aimed to establish comparisons; explore RL critical ideas or actions observed in the PO; and, additionally, understand if, how, and why EB evolved (e.g., How can you improve your students' learning? Where did these new solutions come from? Which experiences from this master's course contradict what you thought about teaching PE?).

Reflective Logs

The individual reflections written by each participant were analyzed in both semesters: first, at the end of the Pedagogical Professionalism curricular unit (first semester) through an individual reflexive task with the theme “learning to be teachers,” which discussed changes in the understanding of self-development as a PE teacher during the first semester. Second, group reflections were conducted after microteaching classes in a school context. These RLs, elaborated by the PSTs during the Sports Specific course units (handball and basketball), focused on instruction, feedback, and pedagogical choices. These reflections, analyzed collectively by the groups and discussed with the course unit teachers, expressed the development of PSTs’ pedagogical practices in the teaching– learning context (Moon, 2013), deepening the understanding of PSTs’ EB and informing the additional data collection moments.

Participant Observation

The participant observations (PO) were conducted to obtain insight into the consistency between the PSTs’ actions and their previously expressed EB. One PO for each participant’s group class was held during Sports Specific course units – handball or basketball (microteaching in school placement) – with the FA as the observer. As a former PETE student, the FA was welcomed in the community (microteaching partner schools and teacher educators), and due to the relationship already developed between the FA and the PSTs, she was not seen as an element that evaluated or judged their actions, creating a trusting environment for data collection to occur.

During PO, a field notes template was utilized to capture nuances otherwise difficult to detect from RL and FG. The observation template was developed considering Hofer and Pintrich’s (1997) framework, and the lesson plan for each PO moment was previously analyzed to identify critical points (e.g., teaching approach, connection between exercises, and student tasks). Special attention was given to class organization, instruction and feedback, and students’ autonomy. These aspects were selected because they could echo EB in a real teaching context, allowing us to understand the alignment between verbalized EB and the PSTs’

practice (May & Curtner-Smith 2021). The information was used to adjust and modify the FG, which aimed to help the PSTs discuss how they believe knowledge should be learned and how they translate that into practice.

Data Analysis

Thematic analysis unfolded by following the systematic process of Braun and Clarke (2021). First, data familiarization occurred over a year, with the immersion of the entire research team in the verbatim transcripts and documents, conducting multiple readings to ensure a deep understanding. This reflexive and critical familiarization of each collection moment informed the next, maintaining a strong focus on the research questions throughout the analysis process.

Next, we focused on finding interesting segments that indicated what PSTs believed and/or why they believed it. Benefiting from the theoretical rigor provided by the EB framework (Hofer & Pintrich, 1997) and considering the phases of OST (Lawson, 1983b), we reflected on the relationships between PSTs' perspectives and experiences, understanding them in their social construction and individual sense-making. In addition, the FA was considered since this analysis derives from seeking connections and meanings that are not evident but are interpreted within the context.

In structuring the themes, we considered that chronological order would bring greater flow in representing the findings since the study aimed to follow the EB changes over time. For example, (a) in the beginning of PETE, "teacher control," "unilateral transmission," and "fixed knowledge" codes ended up on a big theme about acculturation-based beliefs with low sophistication, and (b) references to learning through "group work," "team content manuals," "sports roles," and "peer-feedback" were codes that ended up being part of a larger theme about sophisticated EB about justification for knowledge. Therefore, we chose to reflect on the changes over time, offering insights into the evolution of themes within PETE's first year.

By encouraging the genuine sharing of opinions, we ensured that each participant's thoughts were not influenced and were equally valued by the research team (Patton, 2015). Distinct experiences were actively sought so that the final

analysis would represent the themes in context. The quotes added to the themes of this analysis were reread in their original context to ensure that their representations were a believable reflection of what was transcribed.

Trustworthiness criteria were applied to minimize researcher bias (Nowell et al., 2017): (a) All authors contributed to the conceptualization of the data collection process, ensuring alignment with the research objectives. The FA led the data collection, coordinating logistics and directly gathering the data. The other authors, all experts in the field, collaborated on data analysis, interpretation, and critical review, bringing valuable insights to the process; this process reinforced peer briefings and reflexive auditing to critically assess the analysis process, reduce interpretive bias, and ensure data consistency and accuracy (Patton, 2015); (b) prolonged engagement and diverse data collection methods (FG, RL, and PO) ensured data triangulation; (c) a detailed description of context, methods, duration, and analysis provided a comprehensive understanding of the study; (d) genuine sharing of opinions was encouraged to ensure participants' perspectives were valued and unbiased (Patton, 2015); and (e) all data collection scripts and templates underwent member checking by two experts, while the transcribed FG documents underwent member checking by participants (Stahl & King, 2020).

Findings

The results are presented in chronological order, beginning with the theoretical course units and progressing to practical experiences to understand the development of EB in the first year of this PETE program. The first semester is represented by the theme From Authority to Facilitator – Embracing Students' Active Role Within SCA. The second semester is portrayed by the theme From Student to Teacher – Navigating Epistemic Sophistication Through Hands-on Experiences is organized into two subthemes: Peer-Teaching Contexts – Experiencing EB Sophistication in Practice and Real School Context Negotiations – Acknowledging Epistemic Sophistication About Knowledge.

From Authority to Facilitator – Embracing Student’s Active Role Within SCA

PSTs’ initial perceptions provide a foundation for understanding the development of their EB throughout the PETE. PSTs believed their experiences as students had given them the necessary knowledge about PE content and classroom organization – apprenticeship of observation:

We already have the content; it is inside our heads. We have been studying handball and volleyball for 13 years as school and university students. We already have that content. If you told me to teach any sport, I could do it.
(Sofia, FG1)

This stance exposed beliefs about fixed, noncontextual knowledge without consideration for the development of the subject or the necessary adaptation to the context of each class. PSTs’ beliefs also emphasized teacher authority, hierarchical structures, class control, and the transmission of knowledge. Descriptions such as “a pedagogue, an idol” (Daniel, FG1) and “an example” (James, FG1) reflected the teacher’s central position in the PE class, showing less sophisticated EB about knowing. PSTs saw the teacher as the sole knowledge holder, prioritizing content transmission over students’ diverse abilities. They viewed the class as a space for students to reproduce the teacher’s ideas, emphasizing a technicist approach and students as reproducers.

I do not think the PE teacher’s focus should be on empowering the students; the teacher is there to make them do sports (...). I have the idea of what I want for the class, how I want things to go, and that is what I want to achieve.
(James, FG1)

Unlike others, one participant viewed learning as guided by context rather than solely by the teacher’s intentions or content. Alice showed greater EB sophistication in the early stages of the PETE, emphasizing cognitive involvement, diverse justifications for knowledge, and its contextual nature: “There are things that come from the game. Fair play, knowing how to win and lose, the locker room environment,

the interaction with others. It does not come from the teacher but from the PE classes context.” (Alice FG1).

As the semester progressed, the other participants also demonstrated a shift toward more sophisticated beliefs. Indeed, throughout the first semester, PSTs navigated the tension between their prior beliefs and new theoretical insights, leading to more sophisticated EBs about knowing. When reflecting on their development, they noted how their acculturation-based beliefs were challenged through the process of reflection (present formally and informally during the first semester course units), guiding them toward a new perspective on the PE teaching cycle:

The aspect that stood out the most during class was the importance of teacher reflection, which I had not realized was so crucial for our growth (...). It is through reflection that we can reconstruct our methodologies and our knowledge. Reflective practice provides us with opportunities for development. (James, RL first semester)

This internal negotiation challenged PSTs’ EB and resonated in their receptivity to reconceive PE teaching. The teaching methods course unit, which emphasizes the extensive exploration of different SCA and the teacher’s role as a facilitator, was a key highlight:

What we learned in the teaching methods course is super important. There is no doubt that SCAs have advantages – class cooperation, assigning responsibility, and autonomy. I might have to adjust some things, but even the teachers [teacher educators] said the models are not strict rules. (Lucas, FG2)

Upon initial theoretical exposure to various teaching approaches, PSTs developed new understandings about the teacher’s role, shifting from the idea of being the knowledge authority to “obviously, I have to be a facilitator” (Jack, FG2):

I think one of the areas where I have changed the most is the transmission of ideas. I realized I do not have to impose my own values but rather provide students with a foundation to think critically and shape their perspectives. (Henry, RL first semester)

PSTs began to believe that various approaches could offer valuable personal and social skills. Holding students accountable for their learning through questioning strategies was recognized by the PSTs as a means to increase cognitive engagement and support students' construction of knowledge. As discussed on FG2, when asked about the use of questioning as a form of feedback, James said, "Yes (I would use it), because it helps them think....

It gives them the skills to reflect on what they are doing." Similarly, assigning roles such as coach or referee was viewed to enhance students' knowledge by increasing accountability, responsibility, and autonomous collaborative learning through peer feedback:

Yes, that is important because it helps them assimilate the content easily. If I'm just there doing drills, it is one thing, but if the student is the coach and has to provide feedback, they have to understand the content to correct it, and the students will assimilate it more easily. (Daniel, FG2)

It was also understood that the main idea was to create the best learning environment for students, blending SCAs with more guided teaching and using scaffolding to help students become more autonomous. It was about seeing knowledge and teaching as fluid, connected, and shaped by context – not sticking to just one rigid method (sophisticated EB):

In a class, you can combine different models (...). As we were told in the teaching methods course, there can be moments for direct instruction and for SCAs. After all, we are there to teach, and we have to assume that students do not start with an incredible autonomous capacity. (Alice, FG2)

Nevertheless, this process involved inherent challenges. The lack of knowledge about sports content was highlighted as a difficulty during real school context practice:

I think initially, we will tend to use direct instruction because we have less experience and knowledge about the subject. You need to be an effective teacher to move away from the direct instruction model (...) because it gives us more security. (Sofia, FG2)

This aspect was identified as a tension in their EB development and potential factor leading PSTs to revert to the role of the knowledge authority and the understandings formed during their acculturation phase.

From Student to Teacher – Navigating Epistemic Sophistication Through Hands-on Experiences

Although PSTs understood the importance of the first semester, they realized the need to complement this knowledge with its practical application:

In the 1st semester, we had more theoretical courses. It helped me change my thinking because I learned important things that will inform my future practice. But now, I really want to go to school and put it into practice. (Lucas, FG2)

The second semester marked most PSTs' first experience as PE teachers. They engaged in both simulated practice with peers and microteaching in real school settings, which served as catalysts for belief sophistication. Two subthemes, one for each experience, are presented.

Peer-Teaching Contexts – Experiencing EB Sophistication in Practice

The peer-teaching took place before the school teaching experiences with pupils. This was designed to create opportunities for the PSTs to engage in planning

and teaching a lesson using SCA in a more controlled environment (among PSTs and their teacher educators):

The simulated teaching practices are not like a real teaching context because we are always going to try to help our classmates. (Anna, FG2)

But I also think you have to start with something like this; otherwise, you would be thrown to the lions without trying things out first. (Clara, FG2)

During simulated teaching practices, PSTs engaged in individual and collaborative knowledge building. The sport-specific course units allowed them to explore SCA as both students and teachers, deepening their understanding of cooperative learning:

I think this also ends up developing more cooperation within the group. Maybe in some situations, they will be more united and start to understand what each one can contribute. I think, in that sense, it is interesting. It happened to me in the athletics course. I learned to work together with my team. (William, FG3)

By confronting themselves with the joint development of knowledge, the PSTs could experience the development of their own epistemological sophistication. Additionally, PSTs reported using team manuals (documents given to the class teams with explanations about the lesson content – a characteristic of some SCA). Indeed, having this experience in a peer-teaching context strengthened their beliefs about the potential of SCA strategies and features and led them to maintain these in real practice contexts:

I was [in the role of teacher] in the volleyball class with all the content components in the manual. There was one coach for each team, and the coach explained and showed everything. (...) When I went to the school, in the basketball course, I did exactly the same thing. I saw that it worked to

motivate the students [school pupils] through this interaction with the coaches and for them to manage the exercises on their own. (James, FG3)

By emphasizing the importance that role attribution and the use of the manuals (SCA strategies they explored in their peer-teaching) can play in the class's autonomy, the PSTs were demonstrating that they believed knowledge was constructed beyond the information given by the teacher.

Real School Context Negotiations – Acknowledging Epistemic Sophistication About Knowledge

Throughout the class observations in real teaching contexts, field notes highlighted that PSTs' applied SCA understandings aligned with sophisticated beliefs about the individual construction of knowledge through different sources. Indeed, PSTs "organized tournaments; attempted to integrate referees, table of officials, and coaches; scoring systems added to the activities to create competitiveness; used questioning to provide feedback; delegated responsibility to students to resolve conflicts" (FA field notes during the 2nd semester PO – May 2022).

Additionally, beliefs about evolving, adaptable, transferable, and connected knowledge were also recognized, showing the sophistication of EB about knowledge. It was observed that the "Warm-up has a connection to the sport; dynamic exercises had different solutions; evolution of the tactical and technical complexity of the sport in reduced game situations; knowledge developed in the exercises was transferable between the proposed tasks" (FA field notes during the 2nd semester PO – May 2022).

In fact, the critical aspect of contextual knowledge was developed, emphasizing a circumstantial view of PSTs' ways of teaching. Likewise, the design of the lesson and its operationalization revealed beliefs about the connection and transfer of knowledge:

When we plan reduced games, (...) there is more motor engagement, and I think it is better because there is more transfer for formal settings. (...)

We have to adapt our lesson plan to the students. If they are on the first activity and cannot move on, we cannot stick to the plan. (Daniel, FG3)

Accordingly, PSTs also demonstrated sophistication when believing in evolving and adaptable knowledge. As previously noted by Alice, PSTs should not assume students are fully prepared to have autonomy in PE, and so there is a need to scaffold it (through various teaching approaches, whether through SCA or not). The microteaching experiences at school added further challenges due to the reduced time in contact with the pupils' class before starting to teach. As Alice (FG3) stated, "It is impossible to give the autonomy you want in a class like that. You do not know the students, you have no idea what they are capable of, you do not have time to reach that goal."

Here, PSTs further realized they need time to fully understand students' individual needs and abilities to facilitate the desired autonomy. Additionally, actual teaching experience highlighted another constraint. Being simultaneously the teachers of a PE class and PETE students made PSTs feel it was "a bit unconscious to have certain attitudes because we know we are being evaluated" (Lucas FG3). This was observed through incoherencies using SCAs (such as the illusory autonomy given during the tournaments).

To address these, group reflection with peers and teacher educators helped PSTs rethink their ideas and manage expectations. As William (FG3) shared "In the handball course, we discussed the positive and negative points of the lesson and exchanged feedback. We ended up thinking about what we have done, and we can take this into account when planning the next class." These reflections supported them in understanding how their actions were shaped, fostering ongoing reinterpretation of the PETE content and minimizing setbacks in their professional socialization process.

This ongoing process of reflection helped PSTs recognize the importance of developing their views on knowledge and knowing: "Without PETE, we would end up reproducing the way we were taught. We would end up relying on our secondary school and undergraduate experiences and would be blind about SCA and students' active role in their learning" (Natalia FG3). New knowledge about teaching, interaction with their peers, and reflection on that lived experience redirected the

PSTs' initial understandings and challenged the conceptions acquired during the apprenticeship of observation phase when they were students.

Discussion

This case study aimed to understand the impact of a SCA-based curriculum on the development of PSTs' EB, during the first year of a PETE program. Overall, it was possible to grasp a reconfiguration from less to a more sophisticated EB. This shift was particularly echoed in the PSTs' acknowledgement of adaptability and contextuality of knowledge and preferences for SCA, particularly in the belief that students should be able to develop their own knowledge through different strategies (such as questioning, peer interaction, and role attribution).

When viewed in light of Hofer and Pintrich's (1997) framework, the teaching methods course (first semester) fostered the development of more sophisticated EB by introducing SCA theoretical concepts. These aspects contributed to the process of transition from the belief in teacher authority to the belief in the role of the teacher as a facilitator – EB about knowing. To give them the opportunity to enact the facilitator role, sport-specific teaching course units engaged PSTs in a practical setting for self-evaluation and self-critique processes, strengthening their epistemic sophistication. First, peer-teaching created conditions for PSTs to experience SCA in the role of students as well as teachers in a controlled context (without contextual constraints), reinforcing the development of beliefs about teaching in a cooperative environment and about students' active role – EB about knowing. Second, micro-teaching in real school contexts led them to confront their EB with the constant need for adaptation and the relevance of scaffolding to enhance the students' active role, further sophisticating EB about knowledge.

As shown by Lawson (1983b), PSTs develop beliefs during the acculturation phase, marked by their experiences as PE students, coaches, or athletes. Indeed, at the start of their PETE journey, PSTs had a deeply rooted belief that the authority of knowledge resided in the teacher and in fixed knowledge transmitted unilaterally. This demonstrated less sophisticated EB, increasing the PSTs' passive positioning that could dismiss the potential of PETE to impact their professional development. Considering the demands of current teaching, these EB are at odds with the

autonomy and personal development practices essential for students' personal development (Siedentop et al., 2020). Accordingly, a systematic review of research emphasizes that these ingrained beliefs can significantly impede the successful implementation of SCA (Silva et al., 2021).

During the first year of professional socialization during PETE, we gained insight into the PSTs' growing preference for enhancing students' critical thinking, involving them in the construction of knowledge, and holding them accountable for their class participation, particularly their attitudes toward collaborative and competitive practices. This shows development toward more sophisticated EB about knowing. The EB development and transformation became evident through their pedagogical preferences, which began to align with SCA. Acknowledging the teacher as facilitator and showing preference for cooperation environments, questioning, and students' responsibility (through roles and tasks) illustrated an emerging relation between sophisticated EB and SCA preferences.

The Aypay (2011) study links EB to teaching approaches, associating less sophisticated EB with teacher-centered views, even though the study implemented a distinct framework of analysis. The author also showed that as PSTs advanced through their teacher education, their teacher-centered scores declined, suggesting their education fostered more sophisticated beliefs. Further supporting this connection, Chan and Elliott (2004) also indicated that EB are a reliable predictor of teaching conceptions. However, in the specific context of PE, only Lodewyk (2022) underscored the predictive power of sophisticated EB about the Sport Education Model and the TGfU through a qualitative methodological study. Here, our work adds a longitudinal and in-depth follow-up perspective, not only reporting on the connection between EB and SCA – where this programs' curriculum also includes Cooperative Learning and specific team sports models such as the Step-Game Approach and the IGCM – but also trying to understand which characteristics of PETE can enhance the development of more sophisticated EB.

Another relevant development was on EB about knowledge. PSTs recognized the importance of adaptation and scaffolding in the student's progressive development of learning autonomy – showing beliefs about evolving and contextual knowledge. This emphasized that PSTs believed in the importance of preserving an encouraging learning environment over any instructional or pedagogical innovation.

Indeed, realizing that the school context and students' needs are more important than any professional belief about knowledge and learning is a key aspect that reflects sophisticated EB.

Therefore, we argue that several PETE characteristics influenced this reconfiguration: (a) The integration of theory and practice facilitated a valuable nexus that shaped PSTs' understanding; (b) pedagogical approaches emphasizing SCA characteristics experienced both in the role of students and teachers; (c) practical teaching experiences exposing PSTs to various constraints and conflicts that solidified their epistemological stances; (d) the scaffolded nature of the program, both in the curricular aspect (building theory, peer-teaching, and then microteaching) and in encouraging the gradual introduction of SCA in PE teaching; and (e) critical reflection practices empowered PSTs to be more aware of their beliefs and actions. Accordingly, previous research has already pointed out the importance of providing PSTs with genuine chances to use SCA during initial field experiences as participants and instructors (Gurvitch et al., 2008). This immersion in SCA, both theoretical and practical, allowed PSTs to apply their new pedagogical aspirations. Without these experiences, they might not be able to understand, embody, and implement sophisticated EB across all dimensions.

Furthermore, PSTs acknowledged that reflection was essential for adapting their methodologies and knowledge, recognizing that without it, they risked relying on outdated teaching approaches that would hinder student development. This characteristic has already been enhanced by Azevedo et al. (2024) in the context of PETE, who concluded that reflective practice supported PSTs into looking at their learning activities with more critical and intentional lenses. Ultimately, this emphasizes teacher education should not only focus on content knowledge but also foster reflective practice, critical thinking, and practical application through field experiences and community engagement. (Lawson, 2020).

Nonetheless, some obstacles were identified throughout this process. The lack of expertise in sports content and the dual role of teacher/student (particularly during microteaching in a real school context) were highlighted. These are natural characteristics of the professional socialization phase since implementing SCA can be challenging and might obscure epistemological development (Deenihan & MacPhail, 2017). Additionally, being encouraged to teach through SCA, especially

in sport-specific teaching course units, could have led PSTs to use these approaches solely to satisfy the teacher educator. While the literature highlights the dangers of behaviors, such as projecting desired images to please educators (Graber, 1991; Schempp & Graber, 1992), we observed that PSTs' reflection processes guided them to a more genuine introspection about their development. They did not mask their beliefs to satisfy the research team or teacher educators, demonstrating that the socialization process within PETE remains a dynamic interaction of agency and personal growth, which can influence the development of more robust EB.

Building on this discussion, future research can focus on examining the impact of teacher education on EB and expand its scope by investigating diverse PETE programs and a more diverse range of PSTs to increase representativity. Additionally, questions persist regarding how EB evolve during organizational socialization (Lawson, 1983a, 1983b), as PSTs face the "reality shock" (Veenman, 1984), where real-world teaching further challenges their beliefs. Examining these processes across the various phases of the teaching profession remains essential to understanding the obstacles and strategies needed to foster the sophistication of EB throughout the teacher's career.

Conclusion

This longitudinal case study has provided valuable insights into the changes in PSTs' EB throughout a SCA-based curriculum in PETE. It was understood that PSTs' EB revealed conceptions of fixed and authority-centered knowledge based on their acculturation phase. Over the first year in PETE, however, these beliefs reconfigured toward more sophisticated ones, which manifested in their pedagogical choices guided by SCA.

The way PSTs experienced the theory–practice–reflection nexus through SCA-based experiences reshaped their EB and had practical implications on how these future teachers will perceive PE. Understanding this reconfiguration within specific PETE, emphasizes the need for structured curriculums that integrate student agency and practical engagement, aiming to develop competent professionals ready to meet current and future educational challenges (Lawson, 2020). As the

demand for critical and active students grows (Dyson et al., 2004), the professional socialization phase must create opportunities for PSTs to discover, experience, and reflect on knowledge and pedagogical approaches that enhance students as autonomous members of a democratic learning community.

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Empirical Article 2

The interplay between pedagogical strategies and preservice teachers' epistemological development

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Abstract

Understanding how preservice teachers (PSTs) form their epistemological beliefs (EBs) is crucial for seeing how these beliefs influence teaching practices, particularly whether they encourage active learning or mere knowledge transmission. Building on this premise, this study aimed to understand the interplay between student-centred pedagogical strategies used in a 2-year physical education teacher education (PETE) programme and the development of PSTs' EBs. Data were collected throughout the 2-year PETE programme using a longitudinal case study design, incorporating focus group interviews, reflexive logs, and participant observations with 11 PSTs. Findings reveal a non-linear trajectory across three phases: in the first year, peer-teaching, micro-teaching, questioning, and reflexive practices encouraged the development of more constructivist-aligned understandings. During the transition to school placements, PSTs experienced a 'reality shock' that led to temporary regressions towards control-oriented and authority-based beliefs. In the second year, however, PSTs re-engaged with earlier strategies, reconnecting with beliefs that emphasised student autonomy, collaboration, and active learning. These findings suggest that PETE programmes should deliberately design opportunities for autobiographical, experiential, and professional pedagogical strategies, while providing ongoing support to help PSTs navigate setbacks and progressively develop more sophisticated EBs.

Keywords: Belief development; case study; knowledge construction; teacher education

Introduction

In the theoretical field of beliefs, epistemological beliefs (EBs) refer to individuals' perceptions about the nature of knowledge and knowing (Hofer and Pintrich, 1997). By nature, EBs act as filters for interpretation, evaluation, and decision-making in educational contexts (Kuhn and Weinstock, 2002). Variations in EBs can shape individuals' learning strategies, conceptual development, and problem-solving processes (Chan and Elliott, 2004). Indeed, individuals with more sophisticated EBs tend to promote critical thinking and active learning (Letina,

2022), while those with less sophisticated EBs often focus on knowledge transmission and shallow learning strategies (Otting et al., 2010).

Because of this, fostering more sophisticated EBs has become an important aim in teacher education. Practices such as structured reflection (Brownlee et al., 2001), integrating theory with practice (Schommer, 1994), and promoting critical interpretation (Kardash and Scholes, 1996) have been identified as supportive of preservice teachers' (PSTs') epistemological development. Yet despite these approaches, little is known about how specific student-centred pedagogical strategies might help PSTs transform their EBs towards greater sophistication.

Considering the substantial shifts from teacher-centred approaches towards active learning, there has been an increased recognition of student-centred approaches (SCAs) as part of contemporary pedagogical practice in physical education, supporting a stronger focus on students' active role (Bessa et al., 2020). Accordingly, professional development initiatives have increasingly aimed to align teachers' beliefs and classroom practices with constructivist approaches to education (Sengul et al., 2021). Rooted in discovery and inquiry, constructivism promotes learners' active involvement and agency in their learning journey (Bybee, 2010). This approach supports one's recognition of the evolving nature of knowledge (indicative of sophisticated EBs) which can develop through experimentation and observation (Sengul, 2024).

In physical education teacher education (PETE) research has shown that it has often fallen short of challenging PSTs' assumptions, tending instead to reproduce rather than disrupt their existing, and often less sophisticated beliefs about the purposes, content, and teaching of physical education (Adamakis and Dania, 2020). A shift towards SCA-based practices represents more than a curricular adjustment; it involves rethinking how PSTs engage with knowledge. Through student-centred pedagogies, PSTs are encouraged to critically address their own beliefs (Lodewyk, 2022), reflect more deliberately, and avoid reproducing unexamined acculturation patterns (Schempp and Graber, 1992).

Given the long-standing call for teachers to foster critical thinking and active learning (Dyson et al., 2004), understanding how PETE pedagogical practices support or hinder the development of sophisticated EBs is essential. This is particularly relevant because it is theorised that there is an interplay between

teachers' epistemology and their instructional choices and pedagogical strategies, shaping students' epistemological perspectives on knowledge and knowing (Hofer, 2001). Since PSTs act as both students and teachers, it is crucial to explore how their EBs develop in relation to student-centred strategies in PETE contexts.

Research has been trying to explore the connection between EBs and SCAs (Lodewyk, 2015, 2022). To the best of our knowledge, however, few studies have explored how student-centred pedagogical strategies in PETE programmes can challenge existing beliefs and may influence the development of more sophisticated ones (Ristow et al., 2023). Thus, this case study aimed to understand the interplay between student-centred pedagogical strategies and the development of PSTs' EBs within a 2-year PETE programme. Specifically, this study addressed the following research questions: (a) What is the trajectory of PSTs' EBs across the PETE programme; and (b) How the student-centred pedagogical strategies implemented at each PETE stage might influence this development.

EB conceptualisation

EBs have been conceptualised in several frameworks (Limón, 2006), but in this study, we draw mainly on Hofer and Pintrich's (1997) multidimensional model, as it best captures the domain- and context-specific nature of beliefs. This situated perspective aligns with the view that investigating ways of knowing within specific domains is a crucial direction for educational research (Carlgren, 2020).

Hofer and Pintrich's (1997) theoretical conception comprises two dimensions: EBs about knowledge and EBs about knowing. The dimension of EBs about knowledge concerns views on evolving and transferable knowledge, including questions such as whether absolute truths exist, whether knowledge is continually evolving, and whether simpler theories are more desirable than complex and connected ones. Complementarily, EBs about knowing addresses one's belief about how knowledge is acquired and validated, such as the role of experts as authorities and what kinds of evidence are acceptable to support knowledge construction. These dimensions are often distinguished by their sophistication, with higher sophistication being frequently linked to better learning results than lower sophistication (Muis, 2004).

Research has shown a connection between EBs and teaching practices (Chan and Elliott, 2004), as EBs are thought to influence the preferences and use of pedagogical strategies (Richter and Schmid, 2009). In educational contexts, less sophisticated EBs are commonly linked to surface learning strategies (Schreiber and Shinn, 2003), as they reflect a belief in knowledge as unchanging, an accumulation of isolated facts, and the perception that knowledge comes from authoritative figures, often depending solely on trusting experts (Hofer, 2001). Conversely, sophisticated EBs are associated with deeper, more meaningful learning strategies (Schreiber and Shinn, 2003). Here, knowledge is seen as fluid, evolving, and developed through personal experiences and critical evaluation, involving reflexive judgment and consideration of multiple sources of information (Hofer and Pintrich, 2002). This highlights why student-centred pedagogical strategies that aim at fostering critical reflection, collaboration, and experiential learning can be crucial mechanisms for enhancing the sophistication of PSTs' EBs during PETE.

PETE's pedagogical strategies and their interrelation with EBs

Since 'learning in the ways they are expected to teach may be the most powerful form of teacher education' (Bransford et al., 2005: 76), PETE curricula may play a relevant role in impacting PSTs' EBs. Signature pedagogies (Hordvik and Beni, 2024; Shulman, 2005) identify three categories of approaches that may support PETE in reshaping PSTs' EBs: (a) autobiographical pedagogies, such as questioning and reflection, which encourage PSTs to engage with personal stories and challenge taken-for-granted assumptions; (b) experiential pedagogies, such as peer- and micro-teaching, where PSTs act both as learners and teachers in authentic settings that integrate theory and practice; and (c) pedagogies of professional learning, such as school placements supported by mentors, where PSTs collaborate and critically examine their own practices in professional contexts. Collectively, these approaches illustrate how pedagogical strategies can play a pivotal role in challenging PSTs' EBs and fostering their progression towards more sophisticated understandings of knowledge and learning.

Building on such renewed approaches, pedagogical strategies that engage cognitive processes have been shown to influence PSTs' teaching beliefs (Peralta

et al., 2021) and to assist in deconstructing their beliefs about knowledge (Fletcher and Kosnik, 2016). Reflexive practices can provide environments for evaluating belief systems, potentially leading to the adoption of improved pedagogical strategies and the development of more sophisticated beliefs (Sengul, 2024). Likewise, the use of questioning techniques plays a vital role in fostering deeper reflection and helping PSTs derive meaning from their teaching experiences (Tsangaridou and Polemitou, 2015). As Azevedo et al. (2024) pointed out, questioning that encourages critical reflection can prompt PSTs to adopt a more relativistic stance rather than clinging to a rigid view of absolute truth. In line with autobiographical pedagogies (Hordvik and Beni, 2024), these practices allow PSTs to learn by reflecting on their own experiences, to challenge their assumptions, and to develop a more sophisticated stance towards teaching and learning (Hordvik and Beni, 2024; Shulman, 2005).

Howard et al. (2000) emphasised that hands-on experiences are essential for teacher learning, allowing PSTs to engage in constructivist teaching while learning about it. In PETE programmes, peer teaching provides such opportunities, enabling PSTs to solve problems collaboratively and reflect on their learning in open, discussion-friendly environments (Wahlstrom and Louis, 2008). Peer teaching is explicitly designed to challenge PSTs' beliefs and values about teaching and learning in PE and to encourage critical thinking and reflexivity (Hordvik and Beni, 2024). Similarly, micro-teaching offers PSTs the chance to step into the teacher role, test strategies, and reflect on their effectiveness within a supported and facilitated practice setting. In this way, experiential pedagogies bridge theory and practice, providing authentic contexts that help PSTs confront and revise their epistemological beliefs (Hordvik and Beni, 2024). This is also illustrated by 'living the curriculum' approaches, where PSTs experience teaching strategies as learners and as teachers, while observing teacher educators' reflections and understanding the rationale behind pedagogical decisions (Hordvik et al., 2021; Sinclair and Thornton, 2018).

In addition to university-based learning, pedagogies of professional learning emphasise the importance of school placement as a site for EBs development. Real-school context experiences provide formative situations that confront PSTs with the complexities of practice and the application of demanding pedagogical models

(Sutherland et al., 2010). These experiences support PSTs' ongoing interpretation and reinterpretation of teaching, enabling them to adapt their beliefs, try out emerging approaches, and further refine their understanding of teaching and learning (Lamote and Engels, 2010). When placements are supported by teacher educators and mentors, they provide the safe and collaborative environment that Hordvik and Beni (2024) describe as central to pedagogies of professional learning, encouraging PSTs to critically analyse their own practice and take risks in implementing new approaches.

Furthermore, PETE programmes should deliberately challenge PSTs' preconceived ideas about teaching and learning, offering multiple opportunities to experience, observe, and critically reflect on different curricula and pedagogical strategies (Gurvitch et al., 2008). Nevertheless, it is important to keep in mind that while some strategies might be linked to epistemological reconfiguration, this development is neither automatic nor linear, but contingent on contextual factors and the broader ecological systems of teacher learning (Hordvik et al., 2019; Sutherland et al., 2010).

Study context

This project was developed in a 2-year PETE master's programme in Portugal, which targets PSTs with a bachelor's degree in sports science and grants an official teaching licence. The programme equips PSTs with comprehensive student-centred pedagogical strategies, critical insights into physical education, and practical teaching experiences, including lead-teaching roles for a full academic year under the supervision of cooperating teachers. Its curriculum emphasises a balanced integration of theoretical knowledge and practical application, fostering a strong nexus between theory and practice. The programme encourages pedagogical innovation while maintaining a core focus on sports-specific content. As such, the course design promotes active participation and immersion in authentic settings, particularly within units dedicated to SCAs.

During the programme's first year, PSTs engage in activities such as research, reflection, and cooperative group work, exploring different SCAs and practicing questioning, argumentation, and feedback. These activities scaffold autonomy and

help students transition from seeing the teacher as an authority to acting as a facilitator. They are implemented through peer-teaching and collaborative micro-teaching sessions, where PSTs act as learners and teacher-facilitators in controlled contexts, aiming to develop adaptable teaching strategies for the second-year school placement.

The programme's second year is centred on an immersive school placement, during which PSTs assume lead teaching roles for a full academic year. This placement is guided by a supervisory team composed of faculty teacher educators and a cooperating teacher at the host school. PSTs are responsible for all PE lessons in a class over the course of a school year, which helps them experience the complex, unified nature of teaching and the teacher's role. Through the cooperating teacher, PETE knowledge is connected to the school context, offering structured opportunities for reflection and discussion on practice, planning, challenges, assessment, and policies. To ensure this connection unfolds smoothly and remains cohesive with the programme's vision, cooperating teachers in this PETE programme participate in continuous professional education and specific courses offered by the same faculty.

Methodology

Participants

As the study is grounded in the interpretative paradigm, its relevance emerges from the depth through which it explores the socially constructed and inherently diverse nature of reality (Weed, 2009). Therefore, 11 PSTs agreed to participate in this study, from a total of 120 students enrolled in this PETE programme (see Table 1 for demographic information). Participant selection followed purposive sampling to capture variation in prior experiences, ensuring diverse entry points into PETE. The PSTs brought different backgrounds in the PE field, which shaped their previously developed EBs.

Table 1. Participants' demographic information

Name	Age	Sports background
Alice	20	Athlete/Coach
Sofia	22	Fitness
Natalia	21	Sports management
Clara	22	Athlete
Anna	27	Outdoor Sports Instructor
Jack	27	Coach
Henry	22	Coach (special populations)
Daniel	25	Fitness
Lucas	38	Athlete/Coach
James	21	Athlete
William	21	Referee

The first author's background as a PETE graduate and researcher supported navigation of the data collection process. To ensure reflexivity and reduce potential bias, the investigative process, including conceptualisation, methodological procedures, and ongoing reflection, was collaboratively discussed with the other authors. These included two PhD supervisors who are teacher educators and university supervisors for PSTs in the programme's school placement, and one international expert who is a specialist in PETE teaching and research at an English first-language university. The study was approved by the host faculty's ethics committee (CEFADE 21 2021), with all participants signing informed consent.

Data gathering

This case study sought to capture the complex and often ambiguous interplay between student-centred pedagogical strategies and PSTs' EBs development. Because these strategies were naturally embedded in the PETE curriculum rather than introduced as interventions, the study focused on understanding how PSTs experienced them and how these experiences influenced their EBs. Data were

collected through a 2-year longitudinal follow-up (see Table 2) involving focus group interviews (FGs), reflexive logs (RLs), and participant observations (POs).

Table 2. Data collection timeline

1 st year Curricular year	FG1		
		RLs (course task)	
	FG2		
		Class plan	
			POs1
		RLs (about micro-teaching)	
	FG3		
2 nd year School placement		Audio Recordings	
	FG4		
		RLs (about school placement)	
	FG5		
		Class plan	
			POs2
		RLs (about school placement)	
	FG6		

Note: FG: focus group interviews; RLs: reflexive logs; POs: participant observations.

FGs in this study were designed to encourage PSTs to discuss their beliefs about knowledge and knowing throughout their PETE programme experiences. Conducted three times per year (early, mid, and late PETE stages), each FG included three to four PSTs, totalling 18 sessions of approximately 110 minutes. All interviews were held in faculty settings, audio-recorded, transcribed verbatim, confirmed by participants, translated by the first author, and discussed with the research team to ensure accuracy and integrity. The interview guides were structured to consider the proposed objectives and relevant work on EBs development (Hofer and Pintrich, 2002). FG1 focused on understanding PSTs' initial EBs (e.g. What is the role of the PE teacher? How do PE students learn?). The

remaining FGs (FG2 to FG6) followed PSTs' journeys, preserving similar guiding questions while also exploring if, how, and why their EBs developed (e.g. How can you improve your students' learning? Where did these new solutions come from? Which experiences from this PETE programme contradict what you thought about teaching PE?). Flexibility was maintained to explore emerging topics while ensuring balanced attention to each theme.

Individual RLs were examined at four moments across the PETE programme. The first occurred at the end of the Pedagogical Professionalism course (first semester), when PSTs completed an individual reflection titled 'learning to be teachers', in which they described how their own development as PE teachers had shifted during the semester. The remaining logs (completed after micro-teaching and before FG5 and FG6) focused on PSTs' experiences with instructional decisions, feedback practices, and pedagogical options. All RLs were used with informed consent, and participation did not influence the courses' assessments.

Additionally, at the start of the school placement, PSTs were invited to record an informal audio recording of their first experiences as lead teachers. This moment often brought new responsibilities and uncertainties, so the audio format allowed them to express early impressions more comfortably. The recording focused on initial expectations and challenges, was not linked to any PETE programme requirement or assessment and was accessed solely by the research team.

POs were chosen to understand how PSTs' EBs were enacted, offering insights into aspects of teaching that may not emerge through verbal accounts alone (Öhman and Quennerstedt, 2012). By capturing teaching as it unfolded (particularly pedagogical decisions, class organisation, content delivery, and opportunities for student autonomy), POs complemented the other data sources and provided a more complete view of EBs' development.

Two POs were conducted for each participant over the 2-year follow-up. The first was during micro-teaching in real school settings, and the second was in the final months of the school placement, when PSTs had been leading their classes for over 6 months and were fully familiar with their students and school context. Field notes were used to capture subtle practice features. The observation protocols were guided by Hofer and Pintrich's (1997) EB dimensions and by each class plan

(analysed beforehand) with attention directed to how the lesson was organised, how instruction and feedback unfolded, and how much autonomy students had.

Data analysis and trustworthiness

Thematic analysis was conducted following the systematic process outlined by Braun and Clarke (2021). This process was chosen because it supports an interpretive and flexible engagement with qualitative data, consistent with our aim to understand how student-centred pedagogical strategies shaped PSTs' EBs across the 2-year PETE programme. We adopted a mixed inductive–deductive approach in which Hofer and Pintrich's (1997) framework and the pedagogical characteristics of the PETE programme provided conceptual guidance, while the analysis remained open to contextual insights from the data.

Over the 2 years of the PETE programme, the research team became deeply familiar with the dataset through sustained engagement with the verbatim transcripts of FGs and audio recordings, RLs, and PO field notes, which were read multiple times to gain an overall understanding of PSTs' developmental trajectories. Coding rounds captured segments that suggested the sophistication of PSTs' EBs and/or their perceptions of the influence of programme pedagogy, reflecting on the relationships between their perspectives and experiences shaped by social construction and individual sense-making. All coded extracts were organised to support theme development.

Initial themes captured shared meanings in PSTs' responses to the programme's challenges and forms of support. Given the longitudinal nature of the study and our aim to understand the development of EBs over time, these themes were subsequently organised to reflect the chronological progression of PSTs' EBs throughout the PETE programme. Each theme was then reviewed in relation to both the coded extracts and the dataset to ensure coherence and analytic depth. Through this iterative process, themes were refined, merged, or discarded where necessary (e.g. Re-integrating PETE learning, building pedagogical flexibility and evolving epistemological maturity were merged into the theme: The relevance of flashbacks in reconstructing EBs within the school placement).

Refinement of the final themes was supported by regular discussions within the research team, during which interpretations were negotiated. Themes were organised to reflect the progression across PETE's critical phases: the first curricular year, the transition into school placement, and the school placement itself. This chronological structure allowed the themes to mirror the evolving nature of PSTs' experiences and belief transformations over time.

Trustworthiness criteria ensured methodological rigour and minimised researcher bias. First, prolonged engagement and multiple data collection methods over time enabled data triangulation (Nowell et al., 2017). Detailed descriptions of the study's context, methods, duration, timeframe, and analysis were provided to facilitate a comprehensive understanding, ensuring the research process is transparent and well-documented (Tobin and Begley, 2004). The first author engaged in continuous reflexive dialogue with the research team, and peer briefings critically evaluated the process (Patton, 2015). Additionally, the other authors, all experienced in PETE, contributed to data analysis, interpretation, and critical review, providing valuable perspectives throughout. This collaborative process supported peer discussions and reflexive checks to critically evaluate the analytic process, minimise interpretive bias, and ensure data consistency and accuracy (Patton, 2015).

Findings

The student-centred pedagogical strategies implemented in this PETE programme shaped and revealed how PSTs' EBs evolved over time. This evolution is presented across three themes, each corresponding to a specific temporal phase of the programme: the first year of PETE; the transition into the school context; and the school placement year. Together, these themes highlight the study's central focus on the longitudinal development of PSTs' EBs and on understanding how particular student-centred pedagogical strategies influenced this progression.

First year strategies to challenge one-sided teaching

PSTs' initial perceptions served as a foundation for understanding the development of their EBs throughout the PETE programme. Upon entering the programme, PSTs demonstrated beliefs shaped by their experiences as students and assumed that those experiences provided sufficient knowledge of PE, which reflects apprenticeship of observation:

We have been studying handball and volleyball for 13 years as school and university students; we already know how to teach this content. (Sofia, FG1)

This statement reflected the assumption that prior experience alone was sufficient for teaching, implying a belief in fixed knowledge without acknowledging its evolving nature. PSTs also emphasized class control, and knowledge transmission, believing authority was essential for effective teaching. These perspectives showed that PSTs prioritized content delivery rather than students' individual learning needs:

Teaching is transmitting knowledge (...) I have to know how to apply my ideas to the students and be seen as an example to the people to whom I will be transmitting my knowledge. (William, FG1)

During the first year, four student-centred pedagogical strategies emerged as influential in shaping PSTs' beliefs about knowledge and knowing. These strategies were peer teaching, questioning, microteaching, and reflexive engagement.

Peer teaching appeared to support the development of more sophisticated EBs about knowing. It encouraged cooperation and teamwork by enabling PSTs to experience SCAs both as teachers and as learners. This strategy relied on team manuals and student roles, which helped create a collaborative learning environment:

Henry: I am very motivated to make teams like in athletics.

Natalia: I think it is important to learn to work with each other.

Henry: The students themselves create more autonomy. I can have a captain, and you don't even have to warm everyone up because you split up into groups. They have the manual, and the captain guides it.

William: It even ends up developing more cooperation within the group [...] and they realise what each other can do. It happened to me in athletics.

(FG3 discussion)

By practicing SCAs without the constraints of real school settings, both as students and teachers, PSTs built confidence and recognized that knowledge can be constructed from various sources through personal reasoning. Likewise, questioning emerged as a student-centred pedagogical strategy that appeared to support EBs' sophistication by providing opportunities for cognitive stimulation. PSTs' reflections suggested that asking thought-provoking questions could guide students toward deeper understanding and independent reasoning, rather than simply eliciting correct answers:

I used more questioning feedback on a one-to-one basis to help the student understand and come up with the answer [...] This questioning was one of the things I wouldn't have done if we hadn't talked about it here in the master's program. (James, FG3)

I think it's beneficial [...] it's often about asking questions like 'what do you think this is for?' In other words, asking questions not in such an evaluative way, but more from the perspective of whether they've really learned. (Henry, FG2)

Micro-teaching provided real-context experiences that highlighted the adaptable and pluralistic nature of knowledge. PSTs designed lessons with tasks that encouraged multiple resolutions and connections between activities, showing sophistication in their beliefs about knowledge:

Knowledge developed in the exercises is transferable to the proposed tasks; dynamic exercises focusing on dribbling and passing, giving the student

autonomy to choose the best option; evolution of the tactical and technical complexity of the sport in reduced-game situations. (Field notes from PO1)

This This PETE's student-centred pedagogical strategy also cultivated flexibility in lesson planning. As Sofia observed in FG3, they could not be "[...] afraid to adapt the plan if it was not working. Especially in handball, we often had to adapt because the kids were not keeping up".

Lastly, reflexive practices contributed to the development of EBs' sophistication. Engaging in reflexive practices, fostered personal negotiation and introspection, enabling PSTs to consolidate new understandings about their teaching role:

I used to imagine teaching as a simple process of transmitting knowledge, but I soon realised that it goes far beyond that. Being a teacher is about helping students grow on their own. (Daniel, RL1)

That more introspective and group reflection, talking, I think, had a great effect on our lesson plans, helping us adapt and change them. (Alice, FG3)

Not all forms of reflection, however, were perceived as relevant for this development. Indeed, group discussions and the exchange of ideas with peers were seen as more valued than more structured, written, and individual reflections:

When we are talking with our colleagues, when we discuss things among ourselves about our realities, what we feel, and what we've done, I think that is much more beneficial than often having to write a reflection to submit. (Henry, FG3)

Even with this constraint, reflection, especially when carried out with peers and teacher educators, guided PSTs to better understand their progression toward viewing knowledge as flexible, evolving, and co-constructed, suggesting the development of more sophisticated EBs.

Navigating epistemological setbacks during the reality shock

As PSTs transitioned into their school placement year, they experienced a reality shock, often expressed through the recurring phrase, “They [PETE programme] threw me to the wolves” (audio recording). This overwhelming shift into the school culture and profession pushed PSTs into survival mode. As a result, they reverted to teaching approaches that prioritize control and teacher authority, as they felt safer and more manageable amid the challenges they faced:

I went there super motivated to give students autonomy and make them leaders of their own learning, but when I arrived, I realised I couldn't do that. The students need a lot of control. [...] I have to teach a mix of things, from coaching to activities I used in PE classes when I was a student. (Alice, FG4)

Faced with the complexities of school realities, PSTs found it increasingly difficult to implement the student-centred pedagogical strategies they had been exposed to during the first year of the PETE programme. Instead, they reverted to interventions centred on the transmission of knowledge, such as direct feedback:

I give direct feedback when refereeing a game [...]. Perhaps it was from that experience that I derived this way of giving feedback. (William, FG4)

Moreover, the feeling of being unable to address the disparity in skill levels among students reinforced a more simplistic view of teaching that overlooked the adaptability of knowledge and did not involve differentiation or deeper consideration of students' diverse needs:

The student's ability levels are very different, which makes the lesson boring for the more capable ones, but I cannot resolve this. (Anna, audio record)

This survival mindset highlighted the tension between their EBs and the realities of the school context, leading PSTs to simplify their practices and revert to more control-oriented strategies, returning to authority and fixed routines.

The relevance of flashbacks in reconstructing EBs within the school placement

Once the initial shock of the expectation-reality dilemma was navigated, the school placement year reinforced PSTs' evolving beliefs, balancing the ones established at the start of the PETE programme with the sophistication developed during the first year. As a result, PSTs came to appreciate the importance of flexible teaching practices, adopting a more relativistic approach where they assessed multiple realities within each environment and tried to adapt their strategies accordingly:

The first year was overwhelming; it gave me all the tools I needed. The second year showed me what school really is. The first year had both good and bad aspects, which in part helped me grow but also somewhat constrained me and gave me a school perspective different from what I encountered during the 2nd year [...]. In this school, I could not do what I did last year, and for me, that was a bit of a shock, but it was important at times for me to define the person I am, how I think I should teach, the strategies I believe I should follow, and also to understand if those strategies work in that context. (Jack, FG6)

The school placement year prompted them to reconnect with their EBs development from the first year, particularly on beliefs about knowing. As PSTs flashed back to their peer-teaching experiences, the desire to empower students to take responsibility for their learning became evident. All PSTs, to varying degrees, fostered student agency and engagement in the learning process — revealing teaching perspectives aligned with sophisticated EBs about knowing. Strategies like giving students specific roles, such as "the students who were outside acting as coaches" (Anna, FG6) or as referees to "develop the sports' culture about the rules and signals" (Jack, FG5), promoted leadership and actively contributed to the class dynamics. PSTs also organised team-based activities that encouraged competition

and accountability, successfully applying their sophisticated beliefs to the lesson contexts:

The fact that it is a visible competition, posted on the wall, is something that motivates them from class to class [...] they know that the work has a goal in mind, and they take responsibility. (William, FG6)

By aligning their practices with the SCA fundamentals they experienced during the first year, PSTs showed beliefs in different sources of knowledge and in the active role of the student in its construction:

I opted for the Sport Education Model. There is a team manual, and the captain was truly responsible for implementing it, and they knew exactly what they had to do. If I was not in the class, by reading that, they could manage everything on their own, but it would require a lot of work outside the class. Each team had to organize a tournament to give them that aspect of the organisation, and some of the awards were also related to fair play. (Natalia, FG6)

Likewise, despite differences in school settings and cultures, PSTs recalled from their initial year that questioning was a student-centred pedagogical strategy to encourage students to reflect on their actions and think critically about their learning. As Alice noted, they "really tried to use questioning" (FG6) to promote the self-construction of knowledge. James similarly stated:

In my classes, I use a lot of questioning. Sometimes I let them experiment, then ask, "Why did you do it this way?" Why didn't you do it another way? Little by little, they gave me the answers and told me how they could do it more effectively. I think this also helps them to understand things. (James, FG5)

Drawing on micro-teaching experiences, PSTs relied on their views about evolving and adaptable knowledge to address the natural constraints of the school placement:

The only thing I can say is that each class is different. We might come up with many ideas from PETE and say, 'I will go there and teach all through the game, ' but that is just nonsense. It might work, or it might not; I believe our role is to help students learn, and we have to come up with a strategy to make that happen, whether through games or more analytical exercises. In my view, all these beliefs need to be adapted to the class. (Lucas, FG5)

However, the process was not linear, as challenges persisted. Sometimes, PSTs struggled to adjust their lesson plans to the unpredictability of the context:

He kept the class divided with a physical preparation activity, even when the field was available for all students to participate in the badminton tournament rotation, limiting exercise and involvement in the competition. Students crowded around net 1, leaving net 2 unused, resulting in unequal opportunities for practice. A line formed to access the main mat despite available space for individual practice. (Field notes from PO2)

When questioned, PSTs justified these choices by saying, "I didn't know the space would be available, so I didn't plan for that option" (William, FG6) or "I didn't realise there was free space at the net. I was focused on supervising and giving feedback" (Daniel, FG6). These responses reflected a tendency to prioritize class control, suggesting a reliance on more established routines rather than adaptive strategies to the class's dynamics. Here, by reflecting on their experiences in collaboration with peers and cooperating teachers, PSTs reinforced their commitment to enhance the students' active role and to contextual practices:

Clara: There is a mix of thoughts and reflections that change over time, including beliefs that I altered to implement different teaching strategies that I am still trying to understand gradually. The knowledge, thoughts, and beliefs

I have are of no use if they are only mine, so I now seek to discuss them and hear new perspectives because no matter how good I think they are, there is always something that can be improved. (Clara, RL about school placement)

Their evolving approach to teaching was marked by increasing respect for its progressive nature and the development of the professional confidence required to embrace pedagogical strategies aligned with active student engagement.

Discussion

Through this longitudinal case study, we aimed to explore the EBs development across different PETE moments and to understand the impact of the student-centred pedagogical strategies used within this SCA-based curriculum. Our findings suggest that the development of PSTs' EBs is best understood as a non-linear trajectory, structured across three interconnected phases: development, resistance, and rebuilding. Also, pedagogical strategies grounded in active student learning, cooperation and cognitive involvement promoted a gradual shift toward more sophisticated EBs. Here, the two years of the PETE programme have shown that the strategies experienced by the PSTs have carried over into their practices as teachers, nurturing a constructivist path in the development of the teaching profession.

Student-centred pedagogical strategies' impact on EBs fluctuations throughout PETE

PSTs enter PETE programmes with pre-existing EBs that act as powerful filters, shaping how new understandings are interpreted and guiding their future practice as PE teachers (Curtner-Smith et al., 2008). During the anticipatory socialization phase, after 12 years as PE students and through other experiences as coaches and referees, our participants have constructed their EBs. Ultimately, these beliefs might lead PSTs to resist adopting SCAs' practices and to hesitate to fully take on the role of facilitator (Silva et al., 2021), and they often reflect dualistic views of knowledge—seeing it as fixed, simple, and transmitted by authority.

The first year of the PETE programme, however, opened spaces for alternative epistemologies, creating a sort of development phase for EBs. Early exposure to student-centred pedagogical strategies focused on collaboration and cognitive involvement began to disrupt these assumptions. This shift was evident in their growing appreciation for student responsibility and teamwork. For instance, PSTs highlighted the value of assigning student roles, such as captains, and using team manuals to foster autonomy and cooperation – experiences they had during peer-teaching. Indeed, the implications of giving PSTs authentic opportunities during their early field experiences – both as learners and as instructors – have already been emphasized (Gurvitch et al., 2008). Also, by engaging in ways of knowing focused on the active student role, PSTs understood the importance of the students' cognitive involvement in learning, thereby supporting growth in the sophistication of beliefs about knowing. Likewise, by engaging in planning and implementing lessons together in micro-teaching situations, PSTs began to perceive knowledge as evolving, adaptable and complex – sophisticated EBs about knowledge. The PSTs' growing ability to adapt their strategies to meet students' needs underscored their recognition of knowledge as evolving and co-constructed, further supporting Aypay's (2011) conclusion that teacher education may foster sophisticated EBs over time. These findings resonate with Hordvik and Beni's (2024) categories of autobiographical and experiential pedagogies, which challenge prior assumptions and allow PSTs to live the curriculum in ways that promote belief reconfiguration.

During the transition to a real teaching context in this PETE programme, PSTs took on the role of lead teacher for a class. This moment caused a reality shock and triggered a resistance phase in EBs development, which highlights the non-linear nature of this process. In the initial confrontation with the profession's responsibilities, such as managing a class, the school's culture, and the human and material resources, the PSTs reported feeling helpless and overwhelmed with the assumed obligations. This experience has also been described in other contexts, where the beginning of school placement is characterised by difficulties in teaching tasks and a disconnect between anticipated expectations and classroom realities, often leading to the re-evaluation of ideals formed during the first year of teacher education (Valério et al., 2023; Veenman, 1984). Some PSTs reverted to pre-PETE beliefs rather than applying conceptions developed in the first year. This aligns with

the already documented expectation that at the start of their school activity, teachers will resort to more teacher-centred approaches because those approaches facilitate class control (Mesquita & Graça, 2009) and because pedagogical strategies aligned with SCAs require solid content knowledge and leadership skills (Hastie & Mesquita, 2016). Although the PETE curriculum offered innovative practices, we are not naïve enough to think we have solutions to all the constraints of teacher education. This resistance demonstrates the non-linear nature of EB development, as setbacks form part of professional growth. As Stroot and Ko (2006) concluded, this return to more teacher-centred pedagogies happens regardless of PETE's innovative and critical practices.

This phase also connects with broader socialisation literature. The apprenticeship of observation (Lortie, 1975) and anticipatory socialisation frame how prior experiences re-emerge under stress. Teacher washout, described as the washing out of pedagogical perspectives learned during PETE programmes when incompatible with school culture (Curtner-Smith, 2001; Richards et al., 2014), often begins with reality shock (Banville & Rikard, 2009; Veenman, 1984). Thus, regression under this reality shock is not unexpected but a reinforcement of the already documented mechanism within teacher professionalisation.

Yet rather than abandoning their evolving EBs, PSTs actively engaged in reflection-drawing on first-year experiences, supervisor feedback, and peer discussions to make sense of these tensions. This rebuilding phase enabled a more nuanced and resilient form of EBs, one that balanced pedagogical ideals with practical realities. Importantly, PSTs revisited their first-year experiences and applied student-centred pedagogical strategies more selectively and adaptively, signalling a maturation of their beliefs along the two dimensions. They revisited first-year strategies implemented in peer and micro-teaching situations (such as questioning, accountability, and teamwork) as they resurfaced as reference points, now tested under real classroom constraints. As noted by Silva et al. (2021), short placements (such as those in the first year) often fail to address PSTs' instructional limitations, whereas extended placements (such as a second-year internship) with a clear intervention focus enable significant professional growth and scaffold managerial and instructional domains.

Despite this maturation, translating beliefs to practice was not seamless. The PSTs' doubts and insecurities align with Stran and Curtner-Smith's (2010) findings on early struggles in fostering effective learning and Hordvik et al.'s (2019) observations on reluctance to share leadership with students. Nevertheless, PSTs engaged in reflexive adjustments, gradually refining their approach to align belief with practice in meaningful ways. As found by Azevedo et al. (2024), at the end of their professional internship, PSTs were able to critically reflect on their actions as they figured out who they were as teachers. Reflection operated not only to reconsider practice but as a regulatory tool, allowing PSTs to reconcile tensions between entrenched and newly emerging beliefs.

These findings underscore the value of early, authentic teaching experiences and structured reflection throughout the PETE programme. In fact, PSTs trained in environments guided by constructivist-inspired curriculum reforms tend to adopt strategies with greater student participation and guided discovery (Lee et al., 2013). While the transition from belief to practice is neither smooth nor linear, the interplay of practice, reflection, and support appears crucial in reshaping EBs toward greater sophistication. This re-building reflects Hordvik and Beni's (2024) pedagogies of professional learning, where extended placements and collaborative support enable PSTs to reconstruct more sophisticated epistemologies in context.

Impacting EB sophistication – Recommendations for PETE

By foregrounding the non-linear nature of EB development, we argue that PETE programmes must go beyond linear growth models and instead intentionally scaffold, challenge, and reconstruct beliefs through iterative cycles of disruption and reflection. The findings suggest that PETE can play a key role in strengthening PSTs' EBs, equipping them more effectively for the complex realities of today's schools, particularly when supported by the student-centred pedagogical strategies outlined here. As suggested, greater emphasis should be placed on integrating these strategies in the early stages of teacher education to better align PSTs' beliefs with effective teaching practices.

Firstly, peer and micro-teaching experiences in the first year, which may require further progression in the autonomy and responsibility of the teacher as a single

intervener, fostered a smoother (though still troubled) transition into the school placement year and may have softened the impacts of the reality shock in terms of EBs' sophistication. Indeed, progressive school experiences, coupled with supervision and complemented by activities in the faculty, have been linked to the successful implementation of new ideas about knowledge and knowing (Brouwer & Korthagen, 2005). Nevertheless, attention should be paid to the management of expectations during the transition from first year to school placement, as one way to ease this transition is to be adequately prepared for the realities of the school context (Lawson 1983).

Secondly, PSTs recognized that using thoughtful, open-ended questioning not only deepened student understanding but also supported the development of critical thinking. Since reflectivity is a well-established hallmark of effective teaching, the findings of this study may highlight the importance of teachers thoughtfully considering their actions and how these relate to deeper thinking and belief systems (Soleimani, 2020). The alignment with theoretical insights reinforces the view of questioning as a catalyst for both cognitive stimulation and the evolution of more relativistic, sophisticated EBs.

Finally, combining the above characteristics with a strong reflection component was essential for EBs to mature. Self-reflection, group-based reflection, and reflection with mentors acted not only as mechanisms for awareness but also as regulatory tools to reconcile tensions between old and new beliefs. These reflexive practices helped PSTs reassess their ideas and maintain the will to apply new understandings (Smith & Ingersoll, 2004).

Final thoughts

Through a two-year case study, we learned that EB development is a non-linear process. While the first year appeared to foster the development of more sophisticated EBs, the initial challenges of school placement in the second year emerged as significant obstacles. During this period, a phase of renewed consolidation was observed, with PSTs demonstrating the capacity to return to first-year student-centred pedagogical strategies and re-align their practices to enhance students' active role. Understanding these phases within a non-linear trajectory underscores the importance of PETE programmes that scaffold and rebuild PSTs'

beliefs. Our hope is that this new generation of teachers will believe in the empowerment and autonomy of their students and can continually adapt their understandings to facilitate the best possible environment for physical education.

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Empirical Article 3

The promise and limits of communities of practice for preservice teachers' epistemological beliefs

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Abstract

This study explores how the school placement year in a Physical Education Teacher Education (PETE) program, designed with the intention of fostering Communities of Practice (CoPs), may influence preservice teachers' (PSTs) epistemological beliefs (EBs). Eleven PSTs participated in a longitudinal case study, with data collected through focus groups, reflexive logs and observations. Findings indicate that CoPs can foster sophisticated EBs, where peer and teacher collaboration help PSTs view knowledge as contextual and co-constructed, shifting toward flexible teaching conceptions aligned with the contemporary PE curriculum. However, hierarchical dynamics and the evaluative role of supervisors constrained epistemological growth, limiting opportunities for autonomy and innovation. The study highlights the potential of CoPs to support PSTs' professional development while underscoring structural challenges that may hinder their transformative role.

Keywords: communities of practice; epistemological beliefs; teacher education; preservice teachers

Introduction

In Physical Education Teacher Education (PETE), research has shown that preservice teachers (PSTs) enter their professional training with thousands of hours of classroom experience, giving them familiarity with educational settings and pedagogical practices, which shape their beliefs about knowledge and knowing (Ristow et al., 2023; Schempp & Graber, 1992). During professional development, PSTs' epistemological beliefs (EBs) – beliefs about knowledge and knowing (Hofer, 2001) – are often tied to fixed knowledge and teacher authority (Hammerness et al., 2005). These beliefs filter how PSTs interpret teaching and learning and guide their decisions about curriculum enactment (Kuhn & Weinstock, 2002). Considering this, it comes as no surprise when Soleimani (2018) highlights that studying EBs is a key starting point for initiating changes in the teaching profession.

PETE offers a unique context for understanding how and to what extent EBs adapt, as certain curriculum features encourage PSTs to confront and rethink their existing ideas (Gurvitch et al., 2008). For instance, confronting beliefs acquired

during acculturation (Stran & Curtner-Smith, 2009) and designing programs with consistent messaging and approaches to teacher education exemplify how PETE can challenge and reshape PSTs' thinking (Richards & Templin, 2011; Baker, 2023). Indeed, aligned with broader educational aims to prepare autonomous, reflexive, and socially responsible individuals who can adapt to rapidly changing life circumstances, physical education (PE) has increasingly shifted from the directive characteristic of traditional approaches toward student-centered ones that promote inclusion, participation, and critical engagement (Gubacs-Collins, 2015; Silva et al., 2021). In response to these societal and curricular demands, this PETE reflects the contemporary PE curriculum's emphasis on inquiry, collaboration, and shared responsibility by engaging PSTs in reflexive and cooperative-oriented practice.

Building on this, PETE curriculum such as the one explored in this study also rely on collaborative structures to help PSTs experience these principles in practice. Engagement with professional communities then provides a collective space where these features are brought together, enabling PSTs to reflect on their beliefs, bridge theory and practice, and develop their professional identity (Valério et al., 2023). Communities of Practice (CoPs) challenge traditional teacher development by fostering collaboration and supporting PSTs' ownership of learning (Valério et al., 2023) and such interactions can prompt PSTs to critically examine and reshape their EB (Güven et al., 2014).

Nevertheless, the influence of CoPs on PSTs' EBs during PETE remains insufficiently understood (Ristow et al., 2023). Evidence suggests that integrating theoretical content with practical experience – particularly within CoP frameworks – can reshape teachers' beliefs and practices (Deglau & O'Sullivan, 2006). Exploring these processes among PSTs is therefore essential for understanding how their beliefs evolve and align with, or diverge from, contemporary curricular goals in PE (González-Calvo et al., 2021). Therefore, this study aims to explore how participation in CoPs mediates the influence of the PETE curriculum on PSTs' EBs. Specifically, this research addresses the following questions:

- (1) How do PSTs understand the role of CoPs in supporting their reconceptualization of EBs?
- (2) What challenges do PSTs identify in engaging with CoPs as part of their professional learning trajectory?

Framing epistemological development within communities of practice

EBs are individual beliefs about knowledge and the nature of knowing (Hofer, 2001). The theoretical conception of personal epistemology encompasses two EBs dimensions based on its meaning. First, beliefs about knowledge range from superficial beliefs that there is an absolute truth and that knowledge is an accumulation of facts, to the sophisticated belief that knowledge is contextual, adaptable and interconnected (Hofer & Pintrich, 1997, 2002). Second, beliefs about knowing range from superficial beliefs that knowledge resides in an authority figure (such as the teachers) and is validated by experts, to the sophisticated belief that it comes from self-construction from reflexive judgment on different sources (e.g., classroom experiences, peer discussions, and personal reflection.) (Hofer & Pintrich, 1997, 2002).

As EBs are discipline-dependent, situated in practice, and activated by context (Hofer & Pintrich, 1997), PSTs' previous sports experiences have been informing their epistemological stances (Tsangaridou, 2006), conditioning how they perceive the profession and filter knowledge throughout PETE (Schempp & Graber, 1992). Critically, these pervasive beliefs can be resistant and misguided (Ennis, 1994), and risk undermining initial teacher education. PETE curriculum must therefore guide PSTs toward more sophisticated EBs, where knowledge is seen as evolving, adaptable, and collaboratively constructed from multiple reliable sources (Hofer & Pintrich, 1997, 2002; Lodewyk, 2015). In general education research, reflexive practices and SCA-centered curricula are seen as key for developing sophisticated EBs (Brownlee et al., 2001; Gurvitch et al., 2008). Building on this, PE and sport contexts also highlight CoPs as valuable spaces for teacher development through collaborative learning and shared practice (Lugueti et al., 2019; Patton & Parker, 2017; Stoszkowski & Collins, 2014).

Wenger-Trayner & Wenger-Trayner (2015) describe a CoP as emerging through three interrelated elements amongst the members: i) domain – shared interest –, ii) community – interaction and engagement – and iii) practice – sustained participation. In parallel, these elements could enable the understanding EBs since they are domain-specific, context-dependent and situated in practice (Hofer & Pintrich, 1997). Empirically, engaging in CoPs may foster collaborative discussions around teaching experiences and tensions (Vetter, 2012), leading to increased professional

confidence, reflexive dispositions, broadened perspectives on teaching, and transformations in teachers' beliefs about themselves and their roles (Luguetti et al., 2019). These discussions, encourage PSTs to critically reflect on diverse beliefs and practices, fostering deeper learning and bridging the gap between their beliefs and teaching practices (Hutchinson & Martin, 1999). Additionally, having that social structure for professional learning facilitates PSTs' gradual integration into the teaching profession, fostering the co-construction of knowledge and the development of new skills (Valério et al., 2023).

When considering CoPs as an interesting way of understanding how beliefs change, Stoszkowski and Collins (2014) pointed out that their potential to challenge and reconfigure norms and knowledge cannot be ignored. Indeed, these communities create a safe and open environment where participants can interrogate their beliefs, leading to a richer understanding of their teaching identity (Wong & Liu, 2024). Emerging as platforms for questioning and updating prior beliefs (Damon, 1984), CoPs highlight the value of collaborative peer interaction in fostering the evolution of EBs. This dynamic is particularly effective when knowledge is co-constructed, negotiated, and refined through dialogues within a supportive network (Palincsar, 1998). Nevertheless, socializing forces within schools can shape how PSTs engage with teacher education, affecting their ability to achieve curricular aims (Baker, 2023), including those in both PE and PETE. Tensions can arise from differing priorities of each participant in this group where facilitators (experienced teachers) focus on immediate or future learning outcomes, while PSTs prioritize practical benefits that help address challenges and improve their teaching environment (Wenger-Trayner & Wenger-Trayner, 2020; Valério et al., 2023).

Methodology

A case study approach is particularly effective for advancing research on EBs within PETE, as it enables an in-depth exploration of a specific context (Yin, 2018). To address gaps in the existing literature and provide meaningful insights into the development of EBs within CoPs, this study employed a longitudinal case study design, during the PSTs' school placement.

Research scenario

The PETE program under study is a two-year master's degree in Portugal, accepting approximately 150 students every year. These students, who have completed a bachelor's degree in sports science, receive an official teaching license upon completing the PETE. In the first year, PSTs focus on theoretical concepts, which they explore in practical settings by taking on student and teacher roles through peer teaching and collaborative microteaching. Through these experiences, the PETE curriculum invites PSTs to engage with cooperative settings and explore student-centered approaches, not by directly implementing such pedagogy, but by fostering learning experiences that help PSTs understand and apply these principles.

In the second year, PSTs undertake a full year of school placement, totaling around 450 hours, where they assume the class teacher role, with support from a university supervisor (US) and a cooperative teacher (CT) from the associated school. PETE intentionally places PSTs in groups within the same school, trying to potentiate the cultivation of a CoP in each setting. Here, all participants are expected to learn through action, sharing expertise, and socially constructing knowledge. Formally, CoPs met for about an hour each week, while informal exchanges occurred more often during class intervals or after lessons, sometimes following peer observations. Within the CoP, both PSTs and CTs are encouraged to support one another in learning to teach through experience, discuss curriculum-related cases, and collaborate on school or faculty assignments. When faculty supervisors visit the school, they engage in the group discussions, suggesting future topics for reflection and raising relevant concerns to support the PSTs' professional development.

Participants

Eleven PSTs – in their school placement year of a PETE – were selected through purposive sampling, based on their availability and willingness to participate. These participants ranged in age from 20 to 38 years and shared a common background in sports-related roles, including coaching, fitness training, refereeing, and leading summer camps. As a result, participants brought unique

interpretations and insights to the discussions, enriching the collective understanding. These PSTs were placed in ten different schools located in the northern region of the country, forming ten distinct CoPs together with their peers and the respective CT. Their practice was also supervised by seven different university supervisors, further contributing to the contextual variation within the study.

Data collection

The process began with PSTs' individual audio recordings capturing their views on the initial impact of the school placement. It then examined their professional practices and perspectives within the CoP through focus groups (FG), participant observations (PO), and reflexive logs (RL).

In this study, the FG encouraged PSTs to delve into their perceptions of school placement and increased interactions to access previously unexplored areas of knowledge (Ennis & Chen, 2012). Three FG moments covered school placement's early (FG1), mid (FG2), and late stages (FG3). They were conducted in groups of 3 or 4 participants, totaling nine focus group interviews. FG was conducted in faculty settings, and each session was audio-recorded, transcribed verbatim, and validated by the participants to preserve the integrity of the data. The scripts were structured around EBs dimensions and the collaborative environment within each CoP, with questions such as 'How did the discussions with your peers or the CT influence your ideas and practice? When faced with conflicting perspectives, how did you decide what to believe or apply?'. New issues that emerged were also explored. This approach allowed flexibility in question order and topic development while maintaining control over time.

RL were analyzed in three phases (at the beginning of the school placement and before FG2 and FG3, respectively). These logs documented key events to the research question and highlighted issues considered for subsequent analyses. At the start of the school placement, PSTs recorded an audio log (AR1) to capture their first experiences as lead teachers. Because they were in a new environment and not yet comfortable with formal reflection, these informal records were kept separate from PETE assignments and accessed only by the research team. Additionally, we reviewed individual PSTs' lesson plans and reflections on their teaching (RL1 and

RL2). These written reflections explored PSTs' perspectives on their instructional methods and pedagogical decisions, and the challenges they encountered in their teaching practice.

In this context, PO provided a deeper understanding of what PSTs did in practice beyond their perceptions, offering insights into teaching processes and social dynamics. Because it was conducted in the final months of school, when PSTs had been lead teachers for over six months, the observation captured their practice in a more authentic and established teaching context. By that stage, they were familiar with their students, routines, and available resources, which allowed for a clearer view of their pedagogical decisions, problem-solving strategies, and interactions with the CT and peers. Field note templates captured subtleties that were not easily detected in RLs or FGs. These were developed by the first author considering the EBs dimensions described by Hofer and Pintrich (1997) and the lesson material/plan for each observed lesson.

Data analysis and trustworthiness considerations

The data were analyzed using thematic analysis adopting the systematic process outlined by Braun and Clarke (2021). We began by thoroughly reading all transcripts, logs and field notes to familiarize ourselves with the data. Guided by Hofer and Pintrich's (1997) framework and our aim to explore the influence of CoPs, we developed initial codes capturing key phrases, ideas, and concepts. These were grouped into categories showing similarities, differences, and relationships between PSTs' EBs development and their CoP experiences. EBs about knowledge appeared in participants' views on the adaptability, coherence, and flexibility of content, while EBs about knowing emerged in their reflections on student autonomy, responsibility, and recognition of multiple knowledge sources.

In parallel, we coded CoP interactions based on Wenger-Trayner & Wenger-Trayner (2015), which clustered around two central dynamics: (1) supportive collaboration, including sharing know-how and experimenting with practices, and (2) lack of trust in PSTs, reflecting hierarchical school cultures. Transcripts were then annotated with codes and quotations, analyzed for recurring patterns, and organized into overarching themes. The original transcripts were continuously revisited

throughout the analysis to maintain contextual accuracy and relevance while corroborating codes and themes. This approach facilitated in-depth scrutiny of the PSTs' EBs, shedding light on their perspectives regarding how these CoPs contributed to EBs progression.

To ensure trustworthiness, several strategies were adopted in line with the study's interpretive paradigm (Smith & McGannon, 2018): data triangulation through prolonged engagement and multiple methods; safeguarding participant perspectives by fostering open dialogue, validating transcripts, and valuing all views equally (Patton, 2015); member checking by two experts to validate data collection scripts and templates (Stahl & King, 2020); and peer reviews, reflexive audits, and team discussions to minimize bias and enhance consistency (Patton, 2015). Ethical approval was granted by the [details omitted for double-anonymized peer review], with informed consent obtained from participants and fictitious names used to protect privacy.

Findings

From sharing to sophistication: Collaborative pathways to epistemological growth

'Maybe I can use that too': Sharing as a pathway to contextual and adaptive knowledge.

The ongoing negotiation and sharing of experiences within CoPs created a dynamic learning environment that supported EBs about knowledge as adaptable, contextual, and shaped by multiple perspectives. References to discussions with the CT and peers highlighted how reflexive dialogue within the CoP sustained the co-construction of knowledge. Specifically, the conversations after each lesson emphasized the PSTs' awareness of the need to rethink their plan and improve their practices.

I feel that sometimes things didn't go well, and I knew there was an issue I could have changed or adapted. This awareness comes a lot from what I then

discuss with the CT and with my peers at the end of the lessons. (William, FG2)

These discussions thoughtfully impacted the way PSTs considered the adaptive and contextual needs of their actions. Indeed, their subsequent individual reflections on the lessons mirrored a sophisticated vision in the dimension of EBs about knowledge. A reflexive log by Anna shows how her CoP supported her in moving beyond pre-defined structures, as her recognition of mistakes, adjustments, and engagement in group reflection fostered more adaptive, and situated teaching practices.

During group (PSTs and CT) reflection, I realized I had made some instructional mistakes that I will correct in the next lesson. (...) Feedback from the group helped me see that I should gather the whole class when giving instructions and reduce the time spent explaining, which made me more aware of how to adjust my practice. (Anna, RL1)

The added value of exchanges within the CoP was the adaptive nature of knowledge and its interconnectedness. Although the PSTs led different classes, with diverse characteristics and educational levels, they all benefited from learning, inspiring, and rethinking their practice by considering the experiences of others. As Daniel reflects:

The briefings with my colleagues and CT are great. We don't have the same problems, but maybe I can come up with a solution to their problems that they hadn't thought of, and they can come up with a solution to mine. (FG3)

By conceiving knowledge as connected across different contexts, PSTs could create bridges between their challenges and those of their peers, tailoring solutions that met their unique needs. Similarly, Clara's reflection highlights the important role of peer observation in this process.

This week, we were asked to observe our colleagues' lessons. I observed these aspects and thought to myself if I would do something similar or if I wouldn't make some changes to my lesson. (FG2)

Observing and reflecting on peers' teaching further supports the development of sophisticated EBs, as PSTs engage in critical evaluation and adapt ideas based on multiple perspectives within the community.

'Try it out and see how it goes': From belief to practice in a supportive CoP.

One clear stance emerging from the data is how the CoPs could act as a supportive space for PSTs to experiment with innovative pedagogical approaches that reflect more sophisticated EBs about knowing – seeing knowledge as co-constructed through experience, interaction.

The CT allows us to test some things in class to see how well it can go and whether the students interact. Then, in the internship group (CoP), we tried to define a hybrid model [e.g., combination of characteristics of different student-centered approaches into a flexible mix that adapts to students' needs and contexts.] that responded to what we had seen that made students more motivated and engaged. (James, FG2)

This illustrated a CoP dynamic that legitimizes experimentation and promotes collaborative sense-making through shared reflection on student response and engagement. Similarly, Clara points to an open and flexible environment that encouraged her to take initiative and make pedagogical decisions:

In the approaches, the CT was totally open. I'd sometimes ask him what he thought about forming teams or giving them responsibility in physical activity programs, and he'd tell me to try it out and see how it goes. (FG3)

These examples highlight how trust, autonomy, and dialogue within the CoP supported PSTs in actively shaping their teaching based on judgment, adaptation,

and responsiveness. Also, when CTs adopted approaches rooted in guided discovery, PSTs reported feeling more motivated to reflect deeply on their beliefs and teaching practices. Questioning emerged as a powerful enabler of creative practices aligned with more sophisticated EBs about knowing.

I think the teaching approaches were very trial and error. Then, my CT questioned us in the group meetings, which I loved because I also liked to use that strategy when teaching. That kind of questioning and some literature on teacher knowledge made me realize that I wasn't getting results because my goals weren't well aligned. (Alice, FG2)

Here, questioning becomes not a tool for evaluation but a stimulus for self-construction of knowledge and deeper understanding. In another instance, Alice elaborated on how subtle prompts encouraged epistemological introspection.

The CT wants the reflection to be more when we have meetings (...), and he doesn't say I've done something wrong. He just makes a question mark, and I am supposed to think about that question mark and come to my conclusions with the group. (FG2)

This interaction allowed the PST to consider different perspectives and actively construct meaning within a collaborative setting. Through such collaborative spaces, CoPs reinforced the idea that knowledge is not delivered by authority but built through inquiry, dialogue, and contextual responsiveness. Another key feature of CoPs was the encouragement to justify and articulate one's teaching views. Rather than imposing authority, 'the CT would be willing to innovate and was open to new ideologies like student-centered approaches, if they were adequately justified.' (Clara, FG3) – this positioned knowledge as emerging through dialogue and deliberation rather than compliance. This conditional openness legitimized the PSTs' perspectives and pushed them to refine and defend their pedagogical choices, fostering a more autonomous and critically grounded stance on teaching. Many expressed a desire to implement more student-centered approaches that prioritized autonomy, interaction, and decision-making. While this intention was often present

in their discourse, its translation into practice was necessarily partial and evolving, as expected in a first experience as a lead teacher.

Field notes indicated encouraging signs of this shift by noting ‘Student autonomy is encouraged but in isolated moments during the class, such as during the ‘workout moment’, and decision-making opportunities are regular in reduced-game exercises and the competition moments’. Other observations pointed to ‘early attempts at questioning, though with limitations in timing or impact. Yet, in some cases, more integrated practices emerged, such as elements of the sports education model (a student-centered PE approach, part of innovative pedagogical practices) were used... teams were working within their groups, and coaches were giving feedback’ (FA field note), suggesting that the beliefs explored within the CoP were articulated in class decisions. Even when fragmented, these early enactments reflect the epistemological support for teacher-as-facilitator of knowledge construction.

Power structures and the lack of trust in PSTs

Not all CoPs formed during the school placements aligned fully with the collaborative vision that PETE tried to promote. Each school context, shaped by its specific dynamics and the role played by the CT, introduced structural individuality that made the CoP experience complex and non-linear. For example, when feeling distant from the CT – which limited opportunities for exchange beyond the peer relationship – peer dynamic remained a meaningful site for EBs development.

Talking to Henry, even though he always talks about his context, made me think maybe I can use those tools too. Those conversations we had after class were important because it was with someone who saw my classes and brought different opinions from mine. (Natalia, FG2)

This collaborative reflection fostered a more contextual and adaptable understanding of knowledge. Despite the limitations in forming a triadic CoP involving the CT and the US, these PSTs still engaged in reflexive exchanges that supported sophisticated EBs. In some contexts, however, tensions emerged between PSTs’ epistemological orientations and the more traditional expectations of their CTs.

For instance, Anna explained that ‘the CT wants me to have a firm hand, but I didn't want to make that adjustment to more rigid teaching. It's going to have to be military-like’ (FG1), illustrating how pressure to conform limited opportunities for mutual growth. Similarly, Lucas described the conflict between his preferred approach and the CT's authoritative stance.

Probably, the PST wants to do something, but their CT doesn't allow it or doesn't want them to go down that road. That happens to all of us. My CT wanted a teacher to stand there and give feedback like, 'You, do this. You do that.' but I can't be like that. (FG3)

These stories illustrate how sophisticated EBs about knowing – centered on justification, autonomy, and construction – can be undermined when the CoP lacks alignment or restricts the PST's agency. They also underscore the importance of epistemological resonance within the CoP, where PSTs are not only permitted but encouraged to question, adapt, and co-construct their teaching identity. Indeed, PSTs' challenges emerged when placed in environments where they felt obliged to follow their CTs' preferences. Rather than being encouraged to explore or justify their pedagogical views, they often feel restricted by imposed teaching approaches. This limits their ability to make sense of their EBs contextually and reflectively.

My school and CT follow the PE curriculum very strictly. We follow the rules of the curriculum, and there is a focus on the essential learning document. We're under orders, and we don't have total freedom just yet, so it might be too early to have that definition of being a teacher. (William, FG)

The CT's influence restricts PSTs' autonomy and limits their epistemological development. Instead of fostering critical thinking or adaptive teaching, placement becomes compliance, reflecting a narrow form of curriculum enactment where prescribed documents outweigh adaptive, student-centered interpretation.

Another layer of difficulty stemmed from PSTs not being fully acknowledged in their roles as emerging teachers. PSTs felt that the CT did not consider their perspectives relevant, valid, or experienced enough. While this led PSTs to act more

independently, it often reflected a lack of meaningful guidance or recognition within the CoP.

Because we were so young and new to teaching, I felt that we were marginalized. The CT sometimes thought things were simple because they were basic to him, but they were new to us. On the other hand, it was good because I ended up doing things my way. (Natalia, AR1)

In practice, assessment often overrode participation, and although the US is theoretically part of the school placement CoP, the data reveals a different reality. PSTs rarely mentioned the US, and when they did, it was mainly to highlight the evaluator role the US played rather than a supportive or collaborative one. This suggests a disconnection between the theoretical conception of CoPs and their actual enactment in practice.

The students were very motivated throughout the lesson. I don't know if it was because they felt that the US was there. I was a little reticent and a little anxious because she was coming to observe a lesson, I wasn't so comfortable with. (Clara, RL2)

At the start of the lesson, Daniel gathered the students in the center, and while giving the standard instructions, he told his students that the US was there today and that he was being assessed and asked them to behave themselves. (FA field note)

Instead of being perceived as co-participants in a reflexive dialogue, the US were mainly seen as external evaluators. Their presence invoked formality, pressure, and a shift in the PSTs' behavior rather than encouraging genuine reflection or epistemological exploration. This reinforces a more hierarchical and assessment-oriented dynamic that contrasts with the ethos of mutual engagement and shared meaning-making that defines a true CoP. Consequently, the PSTs' beliefs and practices may have been shaped more by performance concerns than by epistemological growth or pedagogical experimentation.

Discussion and final thoughts

This study explored how participation in CoPs mediates the influence of the PETE curriculum on PSTs' EBs. Our findings show that CoPs – when operating as spaces where curricular intentions are negotiated and experienced – may have a role in promoting more sophisticated understandings of knowledge and knowing. However, we also uncovered persistent structural and relational constraints – especially hierarchical cultures and the assessment-oriented presence of the US – that can limit the epistemological potential of these learning communities. In what follows, we discuss how these dynamics shaped PSTs' EBs, highlighting possibilities and emerging tensions.

While CoPs are constituted by the interplay of domain, community, and practice (Wenger-Trayner & Wenger-Trayner, 2015), reflexive, peer-supported engagement within them were shown to be a mediator in developing sophisticated EBs about knowledge. Through collaborative dialogue, post-lesson reflections, and peer observations, PSTs understood knowledge not as fixed or universal but as contextual, dynamic, and co-constructed. These interactions helped them appreciate the provisional nature of pedagogical decisions and embrace a more situated, responsive stance toward teaching. Indeed, these spaces for sharing and discussing respectfully create conditions under which reflexive conversations about complex and challenging teaching situations can flourish (Patton & Parker, 2017; Wenger, 1998). This had already been documented in a previous study with PE teachers where these spaces encouraged them to engage, share experiences, and co-construct knowledge, strengthening their sense of professional self (Deglau & O'Sullivan, 2006).

In settings where engagement and dialogue were limited to peer interaction – without strong involvement from the CT – these exchanges still played a central role in fostering deeper, more flexible conceptions of knowledge. Decisions about future actions are better informed if the individual participates in reflexive practices and understands how to improve (Stoszkowski & Collins, 2014). In doing so, PSTs moved beyond rigid adherence to pre-set plans and engaged in active meaning-making within diverse teaching realities, illustrating how relational and reflexive spaces can shape the transition toward more sophisticated, adaptive epistemological understandings.

Addressing another EBs dimension, CoPs were also revealed to be incubators for enacting more sophisticated beliefs about knowing, particularly when encouraging trust and experimentation. This finding aligns with prior research showing that CoPs provide conditions for frequent, purposeful exchanges that drive the evolution of teaching practices (Lugueti et al., 2019). When CTs embraced a facilitative rather than directive role, PSTs felt empowered to take pedagogical risks, make justified decisions, and adapt to student needs – behaviors indicative of sophisticated EBs focused on autonomy, justification, and co-construction of knowledge. Facilitating environments where PSTs feel safe to engage in trial-and-error situations supports the development of more sophisticated EBs about knowing, as the enacting of beliefs on innovative curriculum requires time, autonomy support, collaboration, and perseverance to be implemented effectively (Lodewyk, 2022). Dialogic questioning, peer feedback, and the validation of innovative approaches aligned with the PE curriculum fostered conditions for moving beliefs from abstract understanding into pedagogical practice. Ultimately, PSTs' involvement in supportive CoPs influenced not only their EB but also their confidence and commitment to exploring new teaching practices (Patton & Parker, 2017; Deglau & O'Sullivan, 2006).

The enactment of such beliefs, however, was uneven and contingent on the relational dynamics within each CoP. In cases where CTs imposed rigid, teacher-centered approaches, PSTs experienced constraint and tension, illustrating how unidirectional environments can underwhelm epistemological development. Creating value in professional learning requires balancing the drive to act with the need to negotiate and understand the participants' challenges and goals to align them (Wenger-Trayner & Wenger-Trayner, 2020), yet this was often missing in the partnerships between PSTs and CTs. In fact, when the imbalance became too strong, one might question whether these settings functioned as CoPs at all, or merely as groups under the supervision of a single authority. Indeed, our findings suggested that PSTs often arrive in the first year of the PETE program with a strong willingness to experiment with innovative pedagogical approaches, such as student-centered methods. Yet, this orientation sometimes collided with CTs' more traditional views about knowledge and teaching, generating friction in the mentoring relationship. Valério et al. (2023) similarly observed that PSTs' efforts to introduce

new approaches – particularly student-centered ones – were hindered both by CTs' resistance and by their lack of skills to facilitate these practices.

As PSTs confronted discrepancies between their beliefs and their experiences during placements, they developed a heightened awareness of their own assumptions and an openness to trying new ideas (Palincsar, 1998). The contrast across PSTs' school placements underscores the necessity of epistemological alignment within CoPs, affirming that PSTs are more likely to see knowledge as evolving and adaptable and engage with innovative pedagogical approaches when granted agency. It is through individual initiative and negotiation that the members of a CoP define their shared interest, sustain relationships, and co-construct their practice – nurturing the triad domain, community and practice, respectively (Wenger-Trayner & Wenger-Trayner, 2015).

It is essential to recognize that a CoP by itself does not guarantee effective collaboration or meaningful learning – such communities can also be dysfunctional and hinder the learning process (Wenger, 1998). Here, we found that hierarchical dynamics within school placements may constrain PSTs' ability to enact and develop their EBs. In fact, instead of operating within a collaborative and dialogic context, some PSTs found themselves navigating rigid expectations set by their CTs. The CT's dominant role often led to experiences of marginalization, in which PSTs' perspectives were undervalued or dismissed as lacking legitimacy. Such behavior contradicted the facilitator role expected of CTs, who should support PSTs in exploring new teaching approaches while addressing their concerns about how these changes influence community interactions (Guskey, 2002). This lack of recognition inhibited PSTs' autonomy and undermined opportunities for reflexive identity construction.

Even when PSTs attempted to assert independence, it was often out of necessity rather than supported agency. This detachment echoed the work of Valério et al. (2024) where CTs, despite being closely involved in supervision, refrained from engaging in dialogue when challenges arose. These dynamics reflect a fundamental misalignment between the intended collaborative ethos of these PETEs' CoPs and the reality of top-down supervision in some placements.

A similar tension emerged in PSTs' perceptions of the US. Rather than acting as co-participants in reflexive teaching communities, the US was predominantly

viewed as an evaluator. This undermines the relationships of trust, reciprocity, and shared learning that make a CoP possible. Instead of dialogic engagement, the presence of the US produces formality, which fractures the community dimension (Wenger-Trayner & Wenger-Trayner, 2015). In contexts where PSTs interpreted and enacted a PETE curriculum emphasizing student-centered approaches, this dual role of teacher (PST) and learner (PETE student) generated anxiety (Deenihan & MacPhail, 2017), often leading to impression management rather than authentic engagement. When limited to evaluation, the US's role reinforced traditional power structures that inhibited reflection and risk-taking (Valério et al., 2023). This highlights a broader tension in teacher education: the peripheral role of the US represents a missed opportunity to bridge university and school cultures through sustained pedagogical dialogue.

In sum, this study illustrates the central role that CoPs may play in mediating the influence of the PETE curriculum on PSTs' EBs. When structured as supportive, reflexive, and dialogical spaces, CoPs enable PSTs to interpret curricular experiences in ways that encourage viewing knowledge as contextual, adaptive, and co-constructed. These environments legitimized experimentation, critical inquiry, and pedagogical autonomy, helping PSTs move beyond rigid understandings of teaching and learning (Lugueti et al., 2019; Vetter, 2012; Wenger, 1998).

According to Wenger-Trayner and Wenger-Trayner (2020), CoPs provide collaborative spaces that can reshape interactions and foster transformative learning. Within PETE, these spaces mediate how curricular intentions – such as promoting inquiry and student-centered approaches – are experienced and reconstructed by PSTs, leaving a lasting imprint on their beliefs and practices. Yet, to make it possible, CoPs must promote epistemological coherence across domain, community, and practice, grounded in mutual trust and shared purpose. Establishing CoPs in school placements is ineffective if these dimensions remain misaligned, as coherence between curricular goals and practice is essential for meaningful professional development.

To strengthen this mediation process, PETE should understand the institutional and cultural factors shaping CoP relationships and how these influence PSTs' learning experiences. This includes rethinking supervisory roles and fostering collaborative accountability between universities and placement schools, ensuring

that PSTs and supervisors can engage, share expertise, and co-construct pedagogical knowledge. As Valério et al. (2023) suggest, universities could address this by offering ongoing professional learning opportunities to in-service CTs, reinforcing the pedagogical bridge between curricular design and school practice.

Ultimately, by showing how participation in CoPs mediates the PETE curriculum's impact on PSTs' EB – supporting or constraining the enactment of innovative pedagogical approaches – this study contributes to curriculum debates in PE. It underscores the importance of aligning EBs, teacher education contexts, and curricular goals to create coherent and transformative learning experiences.

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The datasets generated during and/or analyzed during the current study are not publicly available due to privacy and confidentiality concerns related to the participants but are available from the corresponding author on reasonable request.

Chapter IV – Final Considerations

4.1. General Discussion

Across the studies, a coherent research agenda was pursued to understand how PETE programs develop and reconfigure PSTs' beliefs about the nature of knowledge and knowing (Hofer & Pintrich, 1997, 2002). This agenda was theoretically grounded in a framework of domain-specific epistemology (Hofer & Pintrich, 1997), and in occupational socialisation theory (Lawson, 1983a, 1983b), which together frame EBs as contextually activated, socially constructed, and shaped across different phases of professional learning. The general goal of this thesis was to understand the impact of PETE on the development and reconfiguration of PSTs' EBs using a longitudinal case study. Additionally, the empirical studies focused on: a) Explore how acculturation-based EB manifestations emerge as PSTs enter the first year of an SCA-based PETE program; b) Understand how PSTs' EBs develop through PSTs' professional socialization within the SCA-based curriculum, including the influence of pedagogical practices on their teaching preferences; c) Follow the trajectory of PSTs' EBs as they progressed through a two-year PETE program, from the first curricular year to the school-placement year; d) To interpret how the pedagogical strategies at each PETE stage may reconfigure the ongoing development and sophistication of PSTs' EBs; e) Explore PSTs' experiences of school placement participation, specifically how engagement in CoPs mediates the influence of the PETE curriculum on their EBs.

As highlighted in the theoretical essay, EBs constitute the cognitive foundation through which PSTs interpret curriculum, pedagogy, and professional roles, and their development is inseparable from the socialisation processes operating within PETE and school contexts. Building on the evidence from the systematic review, our research interest emerged from the recognition that, despite extensive investigation into teachers' beliefs, the epistemological dimension has remained underexplored in PE. The subject has historically been grounded in traditional, performance-oriented, and SCAs paradigms (Mosston & Ashworth, 2008). Current educational and societal demands, however, emphasize inclusivity, participation, and critical engagement (Gubacs-Collins, 2015; Silva et al., 2021). Consequently, PE teachers are increasingly expected to act as facilitators of learning, capable of fostering autonomy, collaboration, and reflexive thinking. This shift demands

epistemological sophistication, enacted by teachers who view knowledge as dynamic, situated, and open to reconstruction through experience (Letina, 2022).

The systematic review and the conceptual essay first established that epistemological beliefs in ITE are best understood as dynamic, context-sensitive, and socially mediated rather than as stable traits or linear stages of development. Building on this theoretical foundation, our empirical studies provide a comprehensive understanding of the epistemological journey of PSTs, from the initial stages of professional socialization to their first experiences as teachers and reveal the non-linear, situated, and socially mediated nature of epistemological development. This collective investigation not only addresses key theoretical and empirical gaps in the literature but also proposes an integrated framework for studying belief development in PETE.

Henceforth, the discussion unfolds with a cross-study synthesis that offers a longitudinal, multidimensional view of epistemological development, followed by an account of the study's contribution to PETE theory and broader teacher education research. It then presents a synopsis of the main findings before turning to the practical implications for PETE, highlighting how program design can deliberately structure learning as an epistemological architecture, how sustained opportunities for reflection and dialogue can be embedded within pedagogical practice, and how supportive professional communities can be cultivated. The discussion concludes by outlining directions for future research that may extend and deepen the understanding of epistemological development within PETE and across teacher education contexts.

Cross-study synthesis: A longitudinal and multidimensional view of epistemological development

When considered collectively, our findings present a coherent narrative of epistemological growth that unfolds over PETE. Resonating with the perspectives of personal epistemology and OST, which posits that beliefs are progressively restructured through contextual challenges, this growth can be described as progressing through three interconnected stages, corresponding to the phases investigated across the studies: (1) early professional socialization and exposure to

student-centered curricula, (2) the consolidation and disruption of beliefs through pedagogical strategies, and (3) the contextual negotiation of epistemological sophistication within CoPs.

The two theoretical studies provided the conceptual backbone for the empirical investigation by framing EBs as domain-specific, socially situated, and shaped through professional socialisation processes. Drawing on personal epistemology (Hofer & Pintrich, 1997, 2002), OST (Lawson, 1983a, 1983b), and the systematic mapping of EBs research in initial teacher education, the theoretical work highlighted some key premises. One about epistemological development being context-sensitive and mediated by curricular and pedagogical structures, particularly student-centred and reflexive learning environments. Also, EBs development is non-linear, requiring longitudinal and qualitative approaches to capture moments of disruption, regression, and reconstruction. These premises directly informed the design and sequencing of the three empirical studies, which were intentionally organised to follow PSTs across successive phases of PETE (curricular year and school placement), to understand how learning environments operate as epistemological mediators, and to capture the dynamic interplay between individual belief systems and institutional contexts over time.

In the first empirical article, PSTs entered PETE with beliefs largely shaped by their previous experiences as students and athletes. These beliefs reflected teacher-centered assumptions, where teaching was associated with transmitting knowledge and maintaining control over students (Hammerness et al., 2005). Early engagement with a SCA-based curriculum challenged these assumptions by introducing models such as Teaching Games for Understanding (Bunker & Thorpe, 1982), Cooperative Learning (Dyson & Casey, 2016), and the Sport Education Model (Siedentop, 1994). Through reflexive discussion, peer-teaching, and micro-teaching, PSTs began to appreciate knowledge as adaptive and contextual. This 1st year of PETE revealed that curricular design grounded in SCA can act as a catalyst for epistemological sophistication, especially when theory and practice are explicitly linked.

While this first empirical study captured the initial disruption of acculturation-based, within a SCA curriculum, the second empirical study extended this picture longitudinally and deepened it by understanding how student-centred pedagogical

strategies within that curriculum supported, challenged, and reshaped PSTs' beliefs over time. This article traced the trajectory of epistemological development over the two years of PETE, revealing that change was neither linear nor uniformly progressive. During the first year, alongside the SCA-based curriculum, strategies such as questioning and reflexive engagement supported the sophistication of beliefs, fostering understandings aligned with sophisticated epistemologies (Letina, 2022). Upon entering the second year of the school placement, however, PSTs experienced a "reality shock" characterized by contextual pressures, classroom management challenges, and institutional expectations. These factors prompted temporary regressions toward traditional, authority-based beliefs as a coping mechanism for uncertainty and institutional pressure. Such regressions do not necessarily signify failure but rather represent critical junctures in epistemological development, during which beliefs are re-examined and eventually reintegrated at a higher level of complexity (Hofer & Bendixen, 2012).

Yet, by revisiting reflexive and experiential strategies (particularly peer collaboration and tutors' feedback), PSTs were able to resignify and deepen their understanding of knowledge as co-constructed and evolving. This oscillation underscores that epistemological development requires sustained support across different learning environments. Thus, whereas this study illuminated the temporal dynamics of epistemological change and the oscillations between sophistication and regression, the need for sustained support PETE directed attention, to the role of social learning spaces during the particularly critical moment of school placement.

Building on that interest, empirical study 3 highlighted the pivotal role of social learning structures during the school placement year. Participation in what was expected to be CoPs allowed PSTs to share experiences, discuss teaching dilemmas, and engage in reflexive dialogue with peers and mentors. Within these groups, knowledge was perceived as contextual and adaptive and negotiated through collaboration rather than imposed by authority. Yet, the same contexts may also perpetuate dependency when mentors impose prescriptive models or discourage experimentation. Thus, epistemological growth is not guaranteed by exposure to practice but depends on the quality of dialogical engagement and the degree to which PSTs are empowered to question and co-create professional knowledge (Valério et al., 2023).

Through this research, we started to think about PSTs' evolving beliefs as a kind of 'rolling snowball.' Each begins with a compact core shaped by prior experiences, and as it moves through PETE, it accumulates new layers of understanding while shedding pieces that no longer hold together when the terrain becomes uneven. In this way, the snowball is continually reshaped, much as PSTs' beliefs develop through ongoing cycles of tension, disruption, and reconstruction. The longitudinal perspective across the empirical studies reveals that the development of EBs is characterized by this dialectical process, reflecting the interplay between personal history, institutional structure, and social interaction. PSTs' beliefs evolve through recursive cycles rather than linear stages, shaped by moments of alignment and dissonance between prior experiences and new educational demands (Ristow et al., 2023).

4.2. Contribution to PETE theory and teacher education research

The integrated findings of these studies advance theoretical, methodological, and practical understanding of EBs' development in several ways.

Theoretically, the research extends existing models of epistemological development by situating them explicitly within the context of PETE. By integrating personal epistemology with OST and a SCA curriculum perspective, it offered a coherent conceptual framework to explain how PSTs' beliefs about knowledge and knowing are challenged, reconstructed, and potentially sophisticated within this PETE. Here, EBs are not only cognitive positions but social practices negotiated within institutional and relational networks. By integrating epistemological theory with OST, signature pedagogies, and CoPs frameworks, these articles offer a multi-level understanding of how beliefs are shaped by personal experience, pedagogical encounters, and contextual interactions.

Methodologically, the theoretical studies exposed the dominance of cross-sectional and quantitative approaches in EBs research and highlighted the need for longitudinal, qualitative, and context-sensitive designs capable of capturing developmental trajectories and moments of disruption and reconstruction. This critique justified and informed the adoption of a qualitative and longitudinal case study approach, for capturing the fluid, context-dependent nature of belief change.

By combining different data collection tools, the research achieved a nuanced understanding of both verbalized and enacted beliefs. This triangulated approach addresses the limitations of prior quantitative studies, which often treated beliefs as static variables (Ristow et al., 2023).

Empirically, it reveals that epistemological sophistication in PETE evolves through the interaction of curricular design, pedagogical strategy, and social context. It identifies specific mechanisms that promote belief reconfiguration. Moreover, it documents the persistent tensions PSTs face in navigating institutional hierarchies and reconciling idealistic educational visions with pragmatic classroom realities. These findings underscore that epistemological development is not merely a cognitive achievement but a form of professional resilience that enables teachers to adapt and sustain reflexive practice under pressure.

Finally, the studies contribute to teacher education more broadly by reaffirming that EBs are foundational to teaching and professional growth. Teachers who perceive knowledge as evolving and co-constructed are more likely to adopt inclusive, inquiry-based pedagogies and to foster critical thinking among students (Dyson et al., 2004; Hastie & Mesquita, 2016). Thus, PETE's success in preparing competent, socially responsive educators depends fundamentally on its capacity to nurture sophisticated epistemological orientations.

4.3. Synopsis of the main findings

The following points summarize the collective findings across the five studies, emphasizing synthesis rather than repetition:

- EBs in PETE are under-theorised and under-investigated, particularly from a domain-specific and longitudinal perspective: The systematic review showed that most EBs research in teacher education (and especially in PE) relies on cross-sectional, quantitative designs and treats beliefs as relatively stable individual attributes. To the best of our knowledge, very few studies adopt longitudinal or qualitative approaches capable of capturing how PSTs' epistemologies evolve across different phases of PETE, revealing a important gap in understanding the developmental, contextual, and socially mediated nature of EBs in this field.

- Epistemological development is inseparable from professional socialisation and pedagogical context: Both the review and the conceptual article demonstrated that PSTs' EBs are shaped by acculturation experiences prior to teacher education and might be reconfigured through participation in specific contexts (whether long or short-term courses) . EBs were therefore conceptualised as domain-specific and situationally activated, emerging through interaction with the norms and power relations operating in university and/or school-based communities.
- EBs are central to teacher learning and professional identity:
PSTs' conceptions of knowledge fundamentally influence their pedagogical reasoning, classroom interactions, and responsiveness to diverse learners. As PSTs' EBs become more sophisticated, they increasingly view teaching as an interpretive and adaptive practice rather than the transmission of fixed content. This shift contributes to the formation of a reflexive professional identity, shaping how PSTs understand their role, authority, and responsibility in learning environments.
- Epistemological development in PETE is non-linear:
PSTs' beliefs evolve through cycles of progression and regression, reflecting contextual pressures and emotional responses to uncertainty. Periods of apparent regression often coincide with heightened accountability demands or unfamiliar pedagogical contexts. These fluctuations indicate that epistemological change is dynamic and situated, requiring sustained support rather than linear expectations of growth.
- SCA-based curriculum functions as a key structural driver of epistemological change:
SCA-based designs foster belief reconfiguration by embedding reflexive, experiential, and dialogic learning opportunities. By positioning knowledge as something co-constructed, these curriculums naturally align with pedagogical models that emphasize student agency, cooperation, and meaningful interaction, which are conditions that actively support the ongoing development and reshaping of PSTs' EBs. Importantly, SCA-based curricula also legitimises uncertainty and negotiation as productive elements of learning,

encouraging PSTs to tolerate ambiguity and question absolutist views of knowledge.

- Pedagogical strategies mediate cognitive and emotional engagement:
Reflection, questioning, and experiential teaching link theoretical knowledge with lived experience, enabling the reorganization of beliefs. These strategies also surface emotional responses that act as catalysts for epistemological reconsideration/setbacks. When intentionally scaffolded, pedagogical strategies can help PSTs integrate affective and cognitive dimensions of learning, strengthening the durability of epistemic change.
- Social learning communities provide epistemological consolidation:
Collaborative reflection and shared inquiry within CoPs support the internalization of sophisticated beliefs. Those environments, empower PSTs to exercise epistemic agency rather than compliance. Conversely, hierarchical supervision can impede this process. Evaluative or authoritarian mentoring relationships may reinforce transmissive beliefs, limiting opportunities for epistemological consolidation.
- Institutional and cultural factors influence belief trajectories:
School structures emphasizing control and performance often privilege certainty and compliance, discouraging epistemic risk-taking and it may constrain epistemological growth. In contrast, cultures that value professional reflection, experimentation, and trust create conditions in which EBs' sophistication can be sustained and translated into practice.

4.4. Practical implications for physical education teacher education

The synthesis of findings across the three studies offers concrete insights for the design, implementation, and supervision of PETE programs. EBs function as the cognitive and affective foundation of teachers' professional reasoning and pedagogical choices. Therefore, fostering epistemological sophistication should not be an implicit expectation of teacher education but an explicit curricular and

pedagogical priority. The following implications outline how PETE can intentionally support this development.

Curriculum Design as Epistemological Architecture

PETE curricula must be conceived as epistemological architectures that support structured environments that intentionally communicate the nature of knowledge as dynamic, contextual, and socially negotiated. This entails integrating constructivist principles throughout coursework and aligning them with practical components. Curricular coherence ensures that theoretical courses on learning, pedagogy, and reflection are consistently reinforced during teaching practice. Embedding SCAs across multiple courses enables PSTs to experience diverse pedagogical models that embody epistemological pluralism (Bunker & Thorpe, 1982; Dyson & Casey, 2016; Siedentop, 1994).

Curricular design should also allow progressive exposure to authentic teaching contexts, moving from controlled simulations to real classrooms. This gradual progression, evident in the empirical articles 1 and 2, provides a scaffold for managing uncertainty while developing reflexive capacity. By intentionally sequencing experiences, PETE can help PSTs construct continuity between conceptual learning and pedagogical action, a key condition for epistemological refinement (Lodewyk, 2022).

Embedding Reflection and Dialogue in Pedagogical Practice

Reflection should be central to PETE's pedagogical philosophy, not treated as an ancillary task. Structured reflexive activities allow PSTs to make their evolving beliefs explicit and to critically examine their assumptions (Moon, 2013). Reflection, however, must move beyond descriptive recounting toward analytical and dialogical engagement. Teacher educators should model critical questioning that connects personal experience with theory, encouraging PSTs to justify their pedagogical choices through evidence and reasoning (Hofer & Bendixen, 2012).

Similarly, peer collaboration and feedback should be normalized as standard pedagogical practice. Micro- and peer-teaching activities provide opportunities for

PSTs to enact their developing epistemologies in safe environments, receive feedback, and revisit their understandings of knowledge in action. As the empirical article 2 showed, such experiential learning supports both confidence and flexibility, fostering an understanding of teaching as inquiry rather than transmission.

Sustaining Communities of Practice Beyond Initial Teacher Education

PETE institutions should consider establishing long-term CoPs that, at least, extend throughout the formal duration of the school placement, supporting PSTs as they transition into professional contexts. Such communities can serve as ongoing reflexive platforms where PSTs revisit and refine their epistemological orientations in light of practical experience. They also promote collective professional learning, bridging the gap between the curricular year and school practice (Wenger-Trayner & Wenger-Trayner, 2015). By fostering collaborative engagement, PETE can help mitigate the risk of epistemological regression often observed during early-career challenges (Ristow et al., 2023).

4.5. Directions for future research

While these articles significantly advance understanding of EBs development in PETE, they also reveal new questions and methodological pathways for further investigation. The following directions are proposed to deepen and expand this line of inquiry.

The studies collectively traced epistemological development across the two-year PETE program, yet the trajectory of these beliefs beyond graduation remains largely unexplored. Future research should employ extended longitudinal designs following teachers into their induction years to understand how EBs evolve in professional contexts shaped by institutional cultures, curriculum demands, and policy pressures. Such research could reveal whether the epistemological sophistication developed during PETE is sustained, transformed, or eroded under the realities of full-time teaching.

Given the domain-specific nature of EBs emphasised in the articles, studies should also explore how different PETE contexts impact the ways knowledge and

knowing are conceptualised in PE. Current findings are derived from a single PETE program within a specific sociocultural and institutional context. Comparative research across different countries, institutional models, and cultural settings would enhance understanding of how local traditions, educational values, and curricular structures mediate epistemological development. Cross-cultural analysis could test the universality of observed patterns and identify context-specific mechanisms that foster or hinder epistemological sophistication (Hofer & Pintrich, 2002).

The articles additionally point to contextually activated character of EBs, suggesting the value of strategies capable of capturing in-situ belief enactment during teaching practice. Further insight into the mechanisms of belief change could be achieved through micro-analytic studies examining reflexive dialogue processes within PETE classrooms and CoPs. Discourse analysis, video-based reflection, and interactional ethnography could reveal how specific conversational moves facilitate epistemological shifts (Braun & Clarke, 2021). Understanding the communicative dynamics of belief transformation could inform more precise pedagogical interventions.

Finally, research should address how institutional and policy frameworks shape the epistemological environments of PETE. Studies could investigate how accreditation standards, curricular mandates, and assessment policies implicitly convey epistemological assumptions about knowledge, learning, and teaching. By connecting micro-level belief studies with macro-level educational policy, researchers can contribute to the design of more coherent systems that support reflexive, critical, and adaptive teacher education.

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