JYX
JYVÄSKYLÄN YLIOPISTO
UNIVERSITY OF JYVÄSKYLÄ

This is a self-archived version of an original article. This version may differ from the original in pagination and typographic details.

Author(s): Kostiainen, Emma; Pöysä-Tarhonen, Johanna

Title: Meaningful learning over the course of teacher education : Students' reflections

Year: 2025

Version: Published version

Copyright: © 2025 The Authors. Published by Elsevier Ltd.

Rights: CC BY 4.0

Rights url: https://creativecommons.org/licenses/by/4.0/

Please cite the original version:

Kostiainen, E., & Pöysä-Tarhonen, J. (2025). Meaningful learning over the course of teacher education : Students' reflections. Teaching and Teacher Education, 168, Article 105241. https://doi.org/10.1016/j.tate.2025.105241

The University of Jyväskylä's Rights Retention Strategy (RRS) enables accepted versions (final drafts) to be made openly available through self-archiving. For more information, see: https://www.jyu.fi/en/rrs

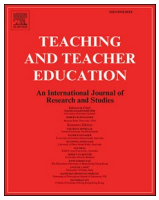
Teaching and Teacher Education 168 (2025) 105241



Contents lists available at ScienceDirect

Teaching and Teacher Education

journal homepage: www.elsevier.com/locate/tate



Research paper

Meaningful learning over the course of teacher education: Students' reflections☆

Emma Kostiainen [a,*], Johanna Pöysä-Tarhonen [b]

[a] University of Jyväskylä, Department of Teacher Education, Ruusupuisto, Alvar Aallon katu 9 P.O. BOX 35, FI-40014, Finland
[b] University of Jyväskylä, Finnish Institute for Educational Research, Ruusupuisto, Alvar Aallon katu 9, P.O. BOX 35, FI-40014, Finland

ARTICLE INFO

Keywords:
Higher education
Teacher education
Pre-service teachers
Situational analysis
Meaningful learning
Teacher professional development

ABSTRACT

In teacher education (TE), meaningful learning (ML) allows pre-service teachers (PSTs) to understand both the content and how they construct their own learning. However, limited research explores these students' experiences of meaningful learning over the course of TE. This study examines 223 PSTs' reflections on meaningful learning during a 5-year master's program in Finland. Situational analysis, including situational, social world/arenas, and relational maps, highlighted the importance of authentic practices and relational and reflective processes in generating meaningful learning. Understanding these experiences is vital for developing pedagogical practices that are emotionally, relationally, and morally sound to better ensure meaningful learning.

1. Introduction

There are frequent calls for reform in teacher education (TE) from different groups, including politicians, educators, the public, and researchers, though these calls often suggest different approaches on what to reform and how (Ball & Forzani, 2009; Bengmark et al., 2024; Yeigh & Lynch, 2017). Educational researchers in particular have long sought effective ways to train teachers that have a positive impact on everyday classroom practice in schools (Loughran, 2006). For example, studies show that teaching graduates perceive the relationship between theory and practice in TE as problematic, often highlighting a gap between these two (McGarr et al., 2016). Although the practical components of PSTs' training strongly influence their teaching, the value of educational theory often remains unclear to them (Bengmark et al., 2024; Whitney et al., 2002). Additionally, teacher education and professional development frequently prioritize preparing teachers to deliver a fixed curriculum over cultivating their capacity for critical reflection and independent thinking (Edwards & D'Arcy, 2004). This raises important questions: What changes and learning processes in TE increase its effectiveness and better equip future teachers for their roles? How can we support pre-service teachers (PSTs) to learn with understanding (Michael, 2001)?

Meaningful learning (ML) is one such method of enhancing PSTs' learning because it shapes PSTs' understanding of what it means to learn—where, with whom, and how (Daves & Roberts, 2010; Esteban-Guitart et al., 2017; Loughran, 2006). ML is thought to produce well-structured, coherent, and interconnected mental models that allow individuals to make inferences and apply knowledge (Karpicke & Grimaldi, 2012). The quality of PSTs' learning is critical to their growth as teachers and the formation of their professional identity, as personal learning is inherently linked to changes in social roles and identity (Ananda, 2023). Drawing on social learning theories, we interpret ML as PSTs' personal and cultural understanding of all experiences during their education, shaped by how valuable these experiences are in relation to their prior knowledge, beliefs, and social context (Okukawa, 2008). ML therefore refers to learning processes, events, activities, and circumstances that students perceive as particularly meaningful, personally valuable, and enriching (Attebury, 2017; Kostiainen et al., 2018, 2025; Mäkinen et al., 2022; Vargas-Hernández & Vargas-González, 2022).

Previous research has outlined the concept and dimensions of meaningful learning (Jonassen & Strobel, 2006; Kostiainen & Pöysä-Tarhonen, 2019), shown how active retrieval supports it (Karpicke & Grimaldi, 2012), and examined didactic strategies used to promote it in higher education (Vargas-Hernández & Vargas-González, 2022), professional development (Patton et al., 2013), and specific fields such as chemistry (Bretz et al., 2013), biosciences (Andrews et al., 2023), and occupational therapy (Perlman et al., 2010). In the context of

☆ We assure that there's no financial or personal interest or belief that could affect our objectivity.

* Corresponding author.
E-mail addresses: emma.kostiainen@jyu.fi (E. Kostiainen), johanna.poysa-tarhonen@jyu.fi (J. Pöysä-Tarhonen).

https://doi.org/10.1016/j.tate.2025.105241
Received 23 April 2025; Received in revised form 27 September 2025; Accepted 1 October 2025
Available online 7 October 2025
0742-051X/© 2025 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

TE, previous research has examined PSTs' ML experiences in the midst of andragogical or adult TE programs (Aarto-Pesonen & Piirainen, 2019; Valli et al., 2017), ML in physical TE (Mäkinen et al., 2022), online TE (Kostiainen et al., 2025), and specific TE courses that are experienced as meaningful (Kostiainen et al., 2018). In addition, researchers have studied ML from different perspectives, such as the effect of emotional cognition strategies on enhancing ML among PSTs (Ananda, 2023). However, research that addresses ML as a phenomenon that cuts across TE is scarce: It is important to examine ML meaningful learning throughout the entire duration of teacher education, as many forms of ML meaningful learning can be processual and consist of the convergence of multiple factors.

In this article, we contribute to this discussion by foregrounding student-teachers' reflections of their own education. We ask: *What do PSTs perceive as meaningful in their learning over the course of TE*? We are interested in what are the key moments that give meaning to the educational journey and foster PSTs' enthusiasm for their chosen profession (see Piercy et al., 2016). By examining students' views on what they find meaningful in their learning throughout TE, and reflecting them against the characteristics of ML presented in the following chapter, we aim to identify the areas, methods and interconnections within TE where ML occurs. Our purpose is to provide key insights into teacher professional development that can serve as a foundation for exploring ML in pre-service TE. Understanding ML is particularly valuable for future teachers because it enables them to integrate these principles into their own teaching practices (Vargas-Hernández & Vargas-González, 2022).

2. Characteristics of meaningful learning in teacher education

Clarke and Hollingsworth (2002) argue that educating teachers is far more complex than is commonly believed. They propose an approach known as *professional development 3.0*, which emphasizes the integration of the personal and professional dimensions of teaching, with the teacher at the center of this intersection. In line with this approach, when studying ML, the focus must be on the learners and their personal experiences—in this case, PSTs and their learning experiences. In addition, the study of ML experiences can provide valuable insights into teachers' professional development. In effect, then, the primary goal of TE through ML is to teach PSTs how to be teachers rather than simply to practice teaching (see Benner, 2012). Such transformation through professional engagement is inherent in teaching, where educators are both learners and contributors in a collaborative learning environment (Clarke & Hollingsworth, 2002).

In this study, we see ML as the learner's personal and cultural interpretation of their educational experiences, shaped by their prior knowledge, beliefs, values, and broader social contexts (Okukawa, 2008). Based on these fundamental principles and earlier research ML can involve several process characteristics that occur when learners engage in (1) authentic practices and (2) active and intentional, (3) reflective and (4) relational, and (5) emotional processes (Kostiainen & Pöysä-Tarhonen, 2019; Kostiainen et al., 2025; Loughran, 2006; Okukawa, 2008; Vargas-Hernández & Vargas-González, 2022). First, given the personal nature of meaningful learning, TE promotes experimenting with diverse course designs and *authentic practices* to foster it. Authentic practices involve viewing instruction as intentionally structured and theory-based, designed to promote understanding rather than rote memorization (Loughran, 2006). However, a persistent challenge remains: Throughout the twentieth century, the gap between theory and practice has remained a central issue in both pre-service and in-service TE (Korthagen, 2017; Lanier & Little, 1986). To close this gap, theoretical understanding should be seamlessly integrated into learning designs for PSTs. Hence, both teaching practice and student tasks play a crucial role in enhancing meaningful learning in TE (Kostiainen & Pöysä-Tarhonen, 2019; Kostiainen et al., 2025). Teaching practice, or practicum, is essential in TE. Feedback from PSTs indicates they highly value learning through practice and find it more beneficial than regular courses (Bengmark et al., 2024; Vanegas-Ortega & Fuentealba Jara, 2024). For instance, authentic practice can be cultivated by providing a theoretical foundation for teaching methods and collaborating with local schools (Kostiainen & Pöysä-Tarhonen, 2019). Learning tasks, whether conducted in person or facilitated through digital technologies, provide additional opportunities for authentic learning experiences (Kostiainen et al., 2025; Lehtinen et al., 2023). These tasks can take various forms, such as tailored case-based instruction, simulations focused on unique instructional scenarios, or collaborative problem-solving. In addition, PSTs consider other concrete aspects of TE, such as teaching and assessment methods and specific course content (e.g., problem-solving), as valuable (Bengmark et al., 2024).

Second, ML also involves taking *active* steps and setting clear personal *intentions*. Through motivation and commitment, learners make a conscious decision to engage in the learning process and actively integrate newly acquired knowledge with their existing understanding (Loughran, 2006). If teacher educators can convince students that they prioritize "understanding"—and if they are aware of the criteria for demonstrating "understanding"—they are more likely to achieve this goal (Michael, 2001, p. 153). Customizing educational programs to learners' needs and encouraging their active involvement can enhance meaningful learning by fostering ownership through self-directed, value-driven processes (Kostiainen & Pöysä-Tarhonen, 2019; Kostiainen et al., 2025).

Third, ML experiences are also cultivated through *reflection*. When PSTs engage in deep analysis and concentration, any situation has the potential to become meaningful as they reflect and deepen their understanding (Kostiainen & Pöysä-Tarhonen, 2019; Körkkö, 2019). Through reflection, PSTs can reconstruct the connection between their learning and themselves, gaining a clearer understanding of the significance of their learning experiences (Okukawa, 2008; Loughran, 2006). Education should promote this construction of meaning, which is best facilitated by proactive involvement from well-prepared educators (Hanani, 2020). In guiding PSTs' reflection skills, teacher educators must not only understand reflection themselves but also find ways to support students as they examine their thinking, experiences, and actions (Kostiainen et al., 2023; Korthagen, 2017). The theory-practice gap—the challenge of reflecting and translating theoretical knowledge into practical application—has long been an issue in TE (Bengmark et al., 2024; Darling-Hammond & Snyder, 2000; Korthagen, 2017). However, research suggests that with appropriate guidance and support, PSTs can critically reflect on their actions, justify their decisions, and link their experiences to theoretical concepts (Slade et al., 2019; Toom et al., 2015). Reflection is also central to pedagogy, enabling PSTs to examine the interplay between teaching and learning and to support meaningful practice and knowledge development. Without reflection, encounters with problematic practices may become routine and superficial, potentially leading to implicit assumptions in teaching (Loughran, 2006). Reflective processes aid PSTs in becoming aware of and addressing the underlying assumptions that guide their actions (Kostiainen & Pöysä-Tarhonen, 2019). Reflective learning requires challenging oneself and acknowledging that meaningful learning can be emotionally demanding, involving cognitive dissonance and even feelings of failure (Kostiainen et al., 2018). These experiences—positive or negative—help shape teacher identity by transforming PSTs' understanding, conceptions, and attitudes.

Fourth, the *relational* aspect of ML underscores the importance of interaction, collaboration, and enthusiasm among teacher educators, PSTs, and the teaching process (Okukawa, 2008). The interaction between teacher educators and PSTs shapes student engagement due to influence from the educator's role. When teacher educators work together with PSTs to manage group dynamics and respond sensitively to their emotions, it can strengthen social interactions within the group, leading to ML experiences (Kostiainen et al., 2018, 2025; Su, 2011). Moreover, interaction, collaboration, and enthusiasm among teacher

educators and PSTs can foster a deeper understanding of the pedagogical reasoning behind teaching processes as experienced by the students (Loughran, 2006). Ensuring equality among all participants in TE, including interactions with teacher educators, training school teachers, and fellow PSTs, is vital as well. When PSTs witness their educators facing similar challenges, it fosters comfort and support. These relational dynamics cultivate learning communities, providing essential support and reinforcing student engagement (Kostiainen & Pöysä-Tarhonen, 2019).

Finally, experiencing, expressing, and exploring a wide spectrum of *emotions* is likewise crucial for ML (Ananda, 2023; Kostiainen et al., 2018, 2025). Emotions have a significant impact on learning and achievement (Pekrun, 2014). A person's emotional state impacts their cognitive performance, as the brain prioritizes processing resources for emotionally significant events (Ananda, 2023). Therefore, it is important to be attentive to the emotions that students experience in their learning (Pekrun, 2014). Learning processes should accommodate various emotions, including feelings of safety, authenticity, trust, struggle, and wonder, to fully unfold (Kostiainen et al., 2018). Emphasizing emotions challenges traditional TE, which has often marginalized affective experiences (Ananda, 2023). Dewey (2024) observes that rational thought is typically prioritized over emotions, which are not always considered ways of knowing. This division has long been part of higher education in general, despite evidence that ignoring emotions can limit deeper learning (Barnett, 2000). Teachers themselves frequently fake or mask their emotions, which can negatively impact their well-being (Taxer & Frenzel, 2015). Research indicates that when PSTs are encouraged to engage with a range of emotions, their learning becomes more meaningful (Kostiainen et al., 2018; Mäkinen et al., 2022), indicating that accepting emotions enhances students' engagement and participation in a course (Su, 2011).

3. Aims

The research question is: *What do PSTs perceive as meaningful in their learning over the course of TE?* By investigating this, we aim to gain a better understanding of how PSTs construct their own learning, which in turn informs the design of educational practices and the creation of favorable conditions for students' ML to flourish during their studies. When PSTs actively construct their own ML—deciding where, how, with whom, and what they learn (Lofthouse et al., 2020; Loughran, 2006)—and this process is visualized through SA (Clarke, 2005), we gain valuable insight into their engagement in acquiring knowledge and skills. Investigating these processes enables teacher educators to identify effective strategies PSTs use, which can inform improvements in teacher education practices and curriculum design. We also strove to shed light on the key dimensions and build on the existing understandings of ML while also providing new insights from students' perspectives. To accomplish this, we applied situational analysis (SA)—a powerful yet significantly underutilized research approach in TE—to not only identify themes across participants' reflections but also to map the relationships, structures, and tensions that shape them (Clarke, 2005; Clarke & Friese, 2007; Clarke & Star, 2008).

4. Methods

In Finland, the education curriculum for primary school teachers includes a 3-year bachelor's program followed by a 2-year master's program (Niemi & Jakku-Sihvonen, 2011). Students complete a total of 300 credits, 120 of which are earned in the master's program. The master's studies consist of compulsory education courses, elective courses, and general studies. The research participants in this study were primary school PSTs (N = 223) in their final year of the 5-year initial TE program at a Finnish university. We collected the data between 2018 and 2023 from PSTs enrolled in the course seminar "Professional Expertise in the Field of Education."

This study employed a cross-sectional design, capturing PSTs' reflections at a single point in their final year rather than tracking the same individuals over time. This approach was appropriate because the focus was on identifying ML experiences as perceived at the end of the TE program, providing a collective snapshot of graduating students' perspectives across several cohorts. The anonymized data (70 pages, Times New Roman, font size 12, line spacing 1, originally in Finnish and translated in English) consisted of individual students' written reflections in which they briefly described the most meaningful issues during their studies, including their reasons for choosing these issues. The exact reflection assignment was as follows: What has been the most meaningful issue/issues for you during your teacher education (e.g., meaningful learning experience)? Why? Students submitted their written reflections through an electronic system where a research information sheet and privacy notice were available, allowing them to indicate whether their responses could be used for research purposes.

PSTs' reflections provide rich data that captures their personal experiences, thoughts, and feelings. This depth of information is invaluable for situational analysis (Clarke, 2005), revealing the complexities of teaching and learning environments. As a method, SA builds on constructivist grounded theory (Clarke, 2005) by emphasizing situated inquiry and integrating human and non-human elements (Clarke & Friese, 2007). Reflections offer contextual insights that are specific to individuals' experiences. This helps in understanding the unique challenges and dynamics of different educational settings, making SA more nuanced and comprehensive. By embracing multiplicity, complexity, and reflexivity, SA offers a constructivist, relativist, and interpretivist approach. It functions as both a methodological toolkit and a critical framework, enabling researchers to navigate messiness, fluidity, and complexity while critically reflecting on their own influence in the research process. In this study, SA was primarily used as a methodological toolkit.

The actual analysis involved two phases (see Table 1). *First*, we analyzed individual students' reflective writings using open coding with the assistance of Atlas.ti data analysis software (Friese, 2014). We began the analysis by immersing ourselves in the data through repeated readings. We then moved to inductive coding with the aim to identify key elements (Clarke, 2005) related to the PSTs' reflections on meaningful learning.

At this first phase, a subset of the data was initially coded to develop a coding framework, with similar codes grouped under common themes. As data accumulated, the full dataset was subsequently coded using the established coding framework. This analytical process resulted in the identification of 18 elements characterizing ML (see Fig. 1), many of which had several points of convergence.

Second, to move beyond the identified elements of ML and visualize their relationships, we applied mapping techniques (Clarke, 2005; Clarke & Friese, 2007; Clarke & Star, 2008). Building on the elements identified in the preceding stage, we created three types of maps—*situational (messy)*, *social world/arenas*, and *relational* (see Figs. 1–8; Clarke, 2005; Clarke & Friese, 2007) to highlight the key elements and perspectives in the situation of inquiry that shaped the PSTs' meaningful learning (Kostiainen & Pöysä-Tarhonen, 2019; Loughran, 2002, 2006).

Mapping started by creating the situational (messy) map (see Fig. 1), which we enriched with data examples to lay out all the elements of ML in the situation of inquiry (Fig. 1). This phase provided the foundation for positioning the codes in relation to the phenomenon studied in order to better construct social worlds/arenas and relational maps.

On this basis, we created the social world/arenas maps (see Figs. 2–7). In essence, social world/arenas maps are the cartographies of a collective activity and aim to visualize individual and collective actors, key non-human elements, and the arena(s) within which they are engaged to show the actions between the different perspectives (Clarke, 2005; Clarke & Friese, 2007). They facilitate detailed examinations of the social, organizational, and institutional aspects of the situation of

Table 1
Overview of the analysis process.

Phase	Activity
Phase 1	Open coding on individual students' reflective writings (N=223) (Clarke, 2005). Coding framework was developed, based on a subset of data.
Phase 2	Mapping techniques to highlight the key elements and perspectives: ↪ Situational (messy) map ↪ Social world/arenas maps ↪ Relational map

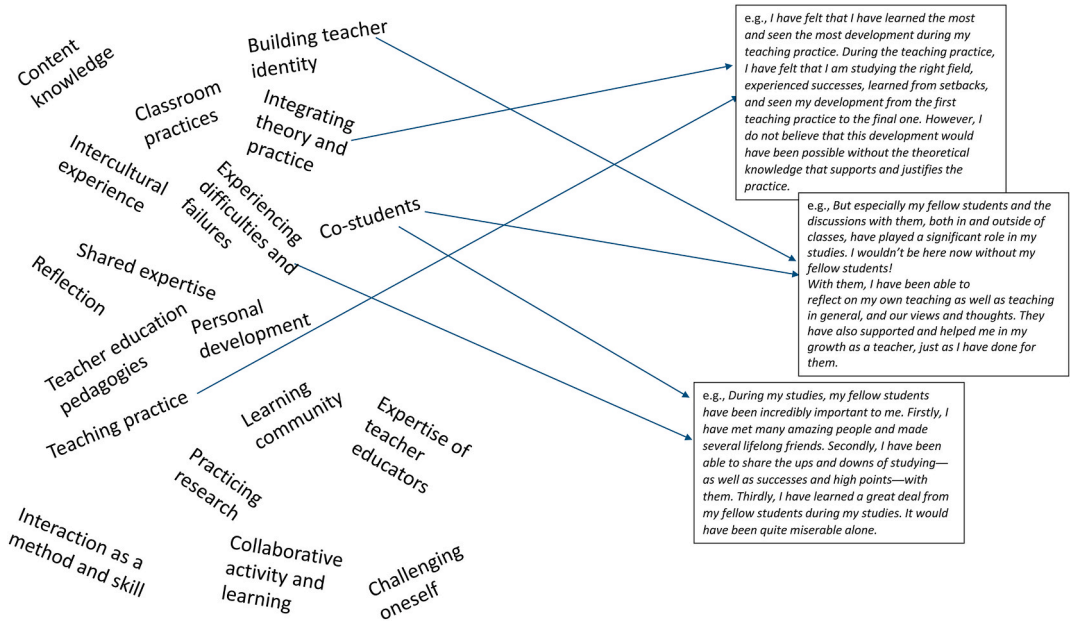


Fig. 1. Situational messy map: Elements and data examples characterizing meaningful learning.

inquiry (Clarke et al., 2022, p. 14) and examine how different types of groups interact and collaborate, focusing on their shared actions and the objects they use in these interactions (Clarke & Star, 2008). This method was particularly well-suited to the study context, as teacher learning is a multilevel phenomenon where cognitive, affective, and motivational sources of behavior are intertwined and embedded in a social context (Korthagen, 2017). Therefore, social world/arenas maps allowed for an empirical analysis of complex situations (Offenberger et al., 2023)—in this case, meaningful learning. Based on the coded elements, we created a social world/arenas map (Fig. 2) that visualizes the arenas of different actors and the learning experiences mentioned as meaningful. Creating the social world/arenas map was a reiterative process (Den Outer et al., 2012). We used the maps to visually represent the relationships and interactions among various social actors and arenas. With the preliminary maps in mind, we revisited the data to identify additional details or nuances that may have been missed during the initial phases. This step involved processes of moving between the coded data and the maps, refining them to enhance accuracy and depth.

The social world/arenas map depicted all collective actors as well as the arenas of commitment (Ahmady & Khani, 2022) in which the PSTs were involved in their learning. In this research, the social world/arenas map consisted of three arenas: the study arena, the training school arena (the school in which PSTs are placed for their practical classroom training), and the teacher educator/researcher arena. In SA, social arenas refer to the broader contexts or fields where various social worlds interact and engage with each other. These arenas are spaces where different groups, organizations, or individuals come together, often with competing interests or perspectives, to address specific issues or concerns (Offenberger et al., 2023). We, the researchers, were positioned in the teacher educator/researcher arena because we were not outside the entire social world/arenas, but rather part of the system as examiners of the phenomenon under study from within. The first author, a teacher educator, taught the course from which the data was collected. The second author, a researcher in education, was not involved in the course. Together, they offer both contextual insight and an external perspective. These arenas emerged through the interplay of theories of ML and

themes derived from the PSTs' reflections.

The elements of ML were positioned according to the significance of their content as experiences by the students within each arena. The placement of the coded elements was based on the thematic content and their entanglement in the data rather than the frequency, with decisions made through careful discussion among the researchers. At this point, the original data—students' written reflections— was also revisited to ensure accurate interpretation. For example, the decision to place "Integrating theory and practice" under "Authentic Practices" and "Active and Intentional Processes", as seen in the Results section, was made because students frequently described how theoretical concepts became most relevant and useful when applied to real teaching situations. This was especially evident in contexts such as teaching practice, where students needed to justify their approaches to practical challenges, such as school bullying, using theory.

The *relational map* (see Fig. 8) illustrated the extent and manner in which the elements of ML related to each other. The relational map helped us determine which stories and connections to investigate (Ahmady & Khani, 2022). This network figure generated using Atlas.ti software, served as a starting point for identifying potential connections and entanglements among various aspects of ML, which were then interpreted within a broader analytical context. The goal was not to equate frequency with meaning but to use the network as a heuristic tool to support deeper interpretive analysis. Although Atlas.ti generates network visualizations based on code frequency and co-occurrence, we approached interpretation critically and supplemented it with in-depth qualitative analysis. Technically, in Atlas.ti software (see Atlas.ti Manual) a *network*—a concept grounded in graph theory—is defined as a set of *nodes* (representing codes or concepts) and *links* (indicating relationships or co-occurrences between them). Each node's *degree* refers to the number of connections it has; for example, a node with a degree of zero is completely unconnected. Another formal property of a network is its *order*, which denotes the total number of nodes it contains. In graphical representations, links are typically drawn as lines connecting the nodes, allowing researchers to visualize the structure and density of relationships within the data. This type of visual mapping can reveal complex patterns and interactions that may not be immediately apparent through linear coding or thematic analysis alone.

In the next section, we present the results first in relation to how the identified elements interconnect and align with each other and the key features of ML—namely authentic practices and active and intentional, reflective and relational, and emotional processes—in the TE social arena. We then present the results according to the most frequently mentioned experiences concerning ML processes over the course of TE and their relation to each other.

5. Results

Next, our results are presented against previous understanding of ML (Kostiainen & Pöysä-Tarhonen, 2019; Kostiainen et al., 2018; Loughran, 2006; Okukawa, 2008). Our results show how engagement in authentic practices as well as active, intentional, reflective, relational, and emotionally rich processes were all intertwined to generate the PSTs' meaningful learning during TE. In the social world/arenas maps, elements of ML are visualized as well as bounded and positioned in the study, training school, and teacher educator/researcher arenas and the world of individual students.

5.1. Authentic practices—Teaching practice above all

The dimension of authentic practices is particularly connected to teaching practice, classroom practices, and the integration of theory and practice (highlighted in Fig. 3). Teaching practices (i.e., PSTs' practical classroom training) are significant for many reasons. Although the practices are challenging and require a lot of work from PSTs, their practical nature is extremely important. During practice, one gets to apply their skills and expertise. In addition to hands-on teaching, discussions with the practice supervisors and their useful feedback are particularly meaningful. Theory and practice most clearly meet in teaching practice, and PSTs can see how their own skills have deepened. The integration of theory and practice and the deepening of expertise are well illustrated in the following student quote:

> "All teaching practices have been particularly significant to me during my studies to become a teacher […] These practices have been significant because the knowledge and skills learned during them have been applied in practice, which has 'clarified' and deepened my own knowledge and skills. By this, I mean that the information that remained unclear and disconnected during courses has been applied in practice during the training, and I have learned to understand it better. The practices have opened my eyes to think about different possibilities and to consider things from various perspectives. In each practice, I have noticed how significantly my thinking has developed and deepened and how the learned knowledge and skills have turned into practice. In this way, I have learned to apply knowledge, and knowledge has turned into action." (S30)

In teaching and classroom practices, PSTs also encounter pupils with their positive interactions and challenges. They understand in practice what it means to support pupils' learning and wellbeing and to consider their individual needs. Understanding student-centered pedagogy is particularly transformative, as the following quote outlines:

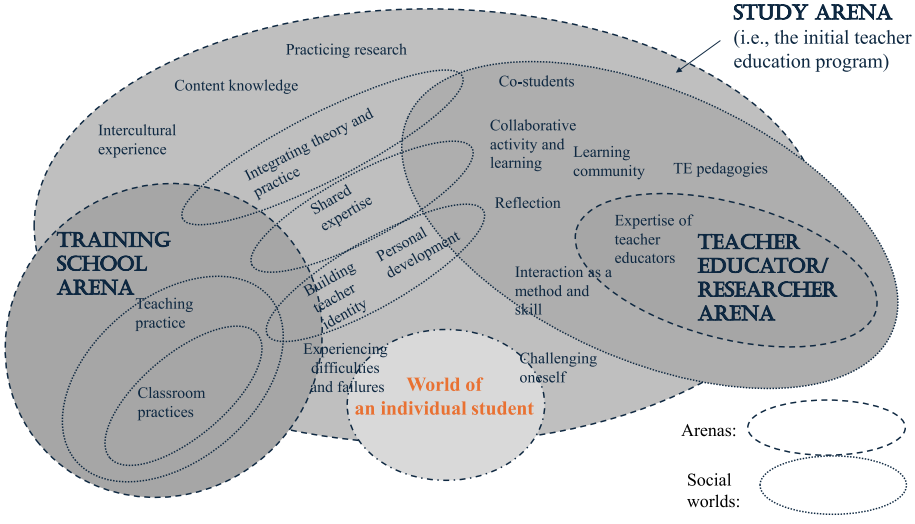


Fig. 2. Social world/arenas map.

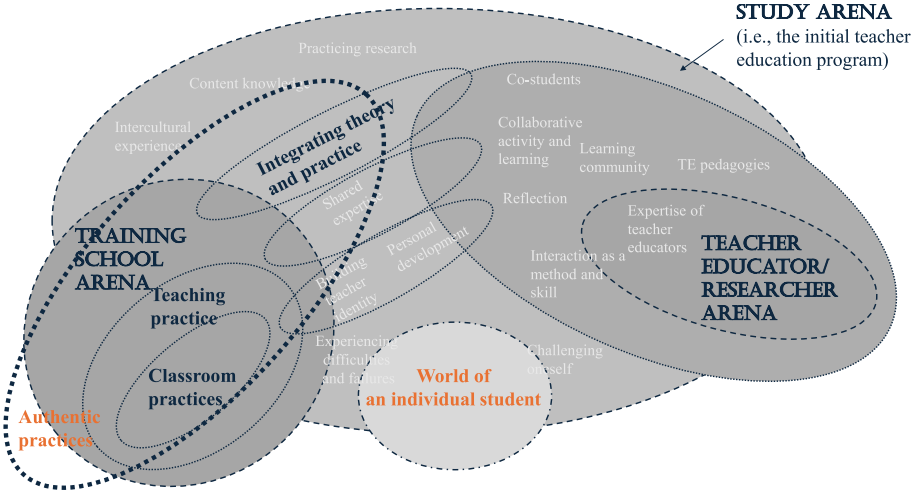


Fig. 3. Social world/arenas map of authentic practices in meaningful learning.

> "The principle of strengthening student-centeredness and participation has been a significant idea for me throughout my studies. It revolutionized my entire understanding of the purpose of school, and during my practices, I have repeatedly realized the immense power of participation. When a student feels that this is their thing or our thing, their motivation immediately soars." (S101)

It seems that there is a slight tension between the training school arena and other study arenas in initial TE: The PSTs most frequently mentioned teaching practice as the most meaningful and most real learning environment compared to other TE processes.

> "[Most meaningful have been] certainly all the projects with schools and teaching practices, because they have given me a real insight into what it's like to be a teacher in the field." (S73)

The social world/arenas map indicates that authenticity is largely realized in the training school environment, offering the most direct connection to the teacher's work: the opportunity to interact with students and to apply and test theoretical understanding.

5.2. Active and intentional processes—Personal interest deepens understanding

The dimension of active and intentional processes is particularly connected to content knowledge and integrating theory and practice (highlighted in Fig. 4). Certain content areas studied in TE motivate PSTs and are considered significant, such as school bullying, changes in the field of education, early childhood and primary education, music education, drama education, and evaluation practices. The themes and content that one is particularly interested in are meaningful in many ways.

Overall, the PSTs considered studies with a practical emphasis as useful. Exploring themes of personal interest also deepened their understanding of important current phenomena. In the following example, a student describes how the understanding of equality in schools gained during a course could be reflected in their teaching in the future:

> "Another significant aspect for me has been the understanding of equality in schools that began with the School and Society course. Through that course, I learned to see the school as a micro-society that 'produces' citizens according to the values of society. Similarly, the injustices present in society are reflected in the school, and the school also perpetuates them. For example, in my group work for this course, we studied gender roles in school, and since then, I have become aware of how these roles are modeled already in kindergarten. The inequality between genders, social classes, and ethnicities seems like an overwhelming challenge, but I […] hope that in my future classroom, everyone will have equal opportunities to learn and find their place in the world." (S102)

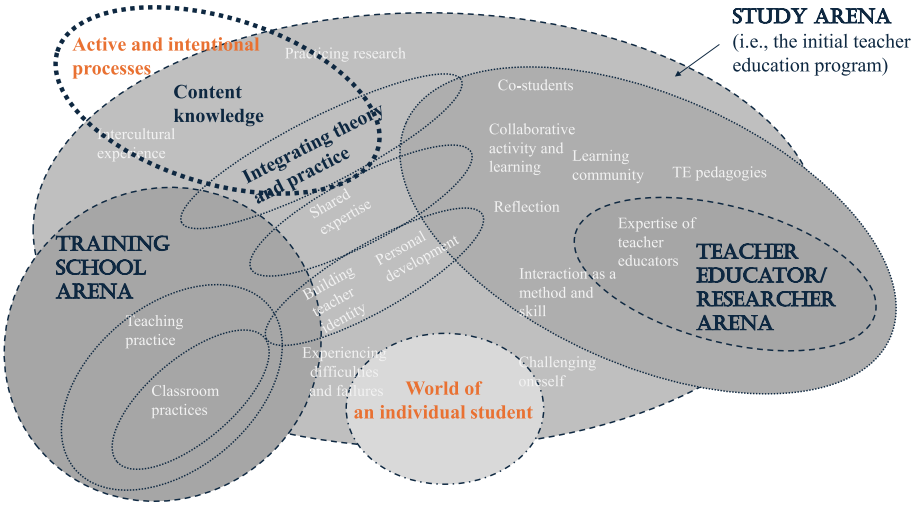


Fig. 4. Social world/arenas map of active and intentional processes in meaningful learning.

The social world/arenas map shows that when theoretical understanding supports practical problems encountered in the learning processes, such as linking assessment content knowledge and practice, it is perceived as particularly meaningful.

5.3. Reflective processes—Co-students serve as mirrors

The dimension of reflective processes is particularly connected to reflection as a learning method, co-students, shared expertise, and building professional identity, as highlighted in Fig. 5. Moreover, reflective processes support personal development, the integration of theory and practice, and practicing research.

Reflection is an essential learning method in TE. The PSTs considered it important that their studies require pausing to think, sharing thoughts, and deep contemplation. As one student said:

> "The first things that came to mind were reflection and shared discussions. In teacher education, I have learned to examine my own thoughts, behaviors, and views through various learning tasks. And there have been many of these. I remember how, early in my studies, I realized the usefulness of reflection and how unique it is to learn it in university studies. I have had many discussions with students from different fields, and I find it extremely valuable how much we teacher students are 'forced' to reflect on everything in our studies. Teacher education is a deep dive into one's own mind, and I don't believe many other fields are similar based on what I've heard. […] My perceptions of school, teaching, and learning have significantly changed over the past few years. Developing the skill of reflection over several years of study has made me realize how reflection now naturally comes up in everyday life. How did I succeed? What could I do differently? Why did I come to this decision? I know I will benefit from this skill in my future work as a teacher, as developing one's teaching is a continuous process. Through reflection, I have also learned a great deal about the complexity of the human mind." (S8)

Co-students are particularly important as reflection partners. Formal pedagogical discussions and especially various informal conversations during lunch, in a café, or even in the sauna were significant to the PSTs' teacher identity and personal development, as well as to linking theory to practice. The students acted as peer support, sparring partners, and encouragers for each other:

> "But especially my fellow students and the discussions with them, both in and outside of classes, have played a significant role in my studies. I wouldn't be here now without my fellow students! With them, I have been able to reflect on my own teaching as well as teaching in general, and our views and thoughts. They have also supported and helped me in my growth as a teacher, just as I have done for them." (S104)

The PSTs also highlighted that the completion of bachelor's and master's theses related to their studies required a reflective approach and mental effort and developed them as people and experts in the field of education.

The social world/arenas map illustrates how reflective processes are at the heart of ML. Reflective processes connect all key learning arenas in TE and all stakeholders involved, including student teachers, teacher educators, and practice supervisors.

5.4. Relational processes—Experiencing equality is significant

The dimension of relational processes (highlighted in Fig. 6) emerged in the PSTs' reflections as a need for interaction, discussions, collaboration, sharing, and enthusiasm in and between teaching staff, students, and the teaching process itself. These elements contribute to the building of learning communities that provide support and enhance student engagement. For the PSTs, the experience of equality was significant. In TE, equality extends beyond interactions with co-students to university lecturers and training school teachers. For the PSTs, observing teacher educators and the role of teachers as equals was important:

> "Both the class teacher and the university teacher [teacher educator] were excellent and encouraging mentors. The discussions I had with them were very valuable to me. The guidance was of high quality because it built an understanding of things dialogically, in my opinion. I felt equal with the mentors—my thoughts were listened to and considered as valuable as theirs. The mentors' perspectives enriched my own thinking, and we were able to discuss matters deeply and comprehensively." (S47)

The PSTs considered the ability of teacher educators to design and shape courses and learning situations to support collaboration and the sharing of expertise as important. TE pedagogical methods that support interaction and a positive atmosphere were also considered meaningful. A permanent, close-knit student group provided many PSTs with a safe environment to learn and discuss difficult topics. The experience of belonging to a learning community was thus important to supporting the PSTs in building a teacher identity and fostering important friendships.

The social world/arenas map illustrates how relational processes are emphasized both in the study arena and the teacher educator's arena. Notably, TE pedagogy supports the building of a learning community and fosters student interaction in both formal and informal contexts.

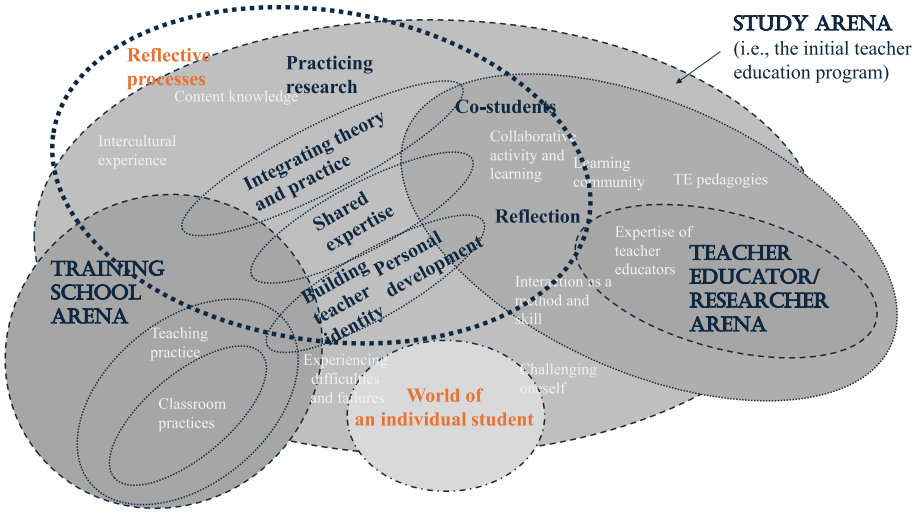


Fig. 5. Social world/arenas map of reflective processes in meaningful learning.

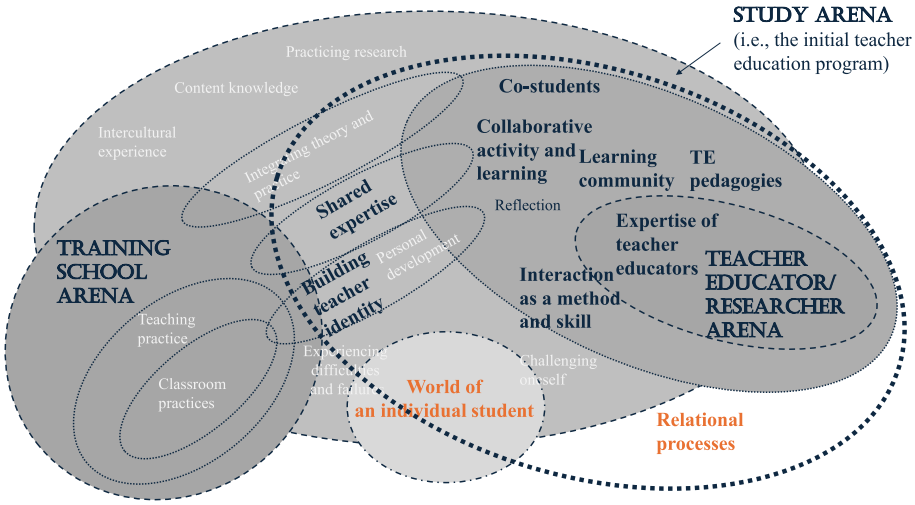


Fig. 6. Social world/arenas map of relational processes in meaningful learning.

5.5. *Emotional processes—Facing challenges helps growth*

In general, the PSTs' reflections on ML emphasized positive feelings toward the processes they mentioned as meaningful due to the nature of the question they were asked. The PSTs often experienced ML as a transformative, eye-opening, or understanding-deepening experience. When describing ML, the PSTs frequently used positive expressions in their reflections, such as "I was fortunate to join a cohort where students are passionate about their field," "it wasn't easy, but it was definitely rewarding," or "I am most grateful for the open and encouraging atmosphere both at the university and the training school."

However, the PSTs considered experiences of difficulties and failures as well as challenges particularly meaningful, as represented and highlighted in Fig. 7. These experiences may have been related to, for example, teaching practice or conflicts with one's student group. During teaching practice, the PSTs encountered other PSTs and mentors with different ways of thinking, which helped them justify their own learning and actions.

The following quote illustrates the experience of facing difficulties during teaching practice:

> "The most significant single entity of my studies was teaching practice 3, where I came into conflict with my own views and abilities. I felt that the mentor and I were at completely opposite ends, and I didn't receive any encouragement or positive feedback from the mentor at all. After the teaching practice, I was discouraged and almost ready to quit my studies and change fields. However, I managed to pull myself together, and now I feel that the experience was really beneficial for me. Being a teacher requires you to justify your actions primarily to yourself and to truly stand behind your work and trust yourself." (S136)

In general, the PSTs considered all situations and processes that challenge PSTs' skills and thoughts as meaningful. When a PST "has to perform," "has to question things and be questioned," and "has to surpass themselves," it is important for learning.

The social world/arenas map illustrates that the variety of learning-related emotions are central to the individual student's world, with challenging and difficult emotions often being deeply personal and difficult to share.

5.6. *Where positions the most meaningful learning in teacher education?*

The relational map in Fig. 8 shows the most frequently mentioned experiences that enabled ML processes over the course of the preservice teachers' TE and their relation to each other. The most frequently mentioned ML contexts and processes were *teaching practice*, *building teacher identity*, *shared expertise*, *integrating theory and practice*,

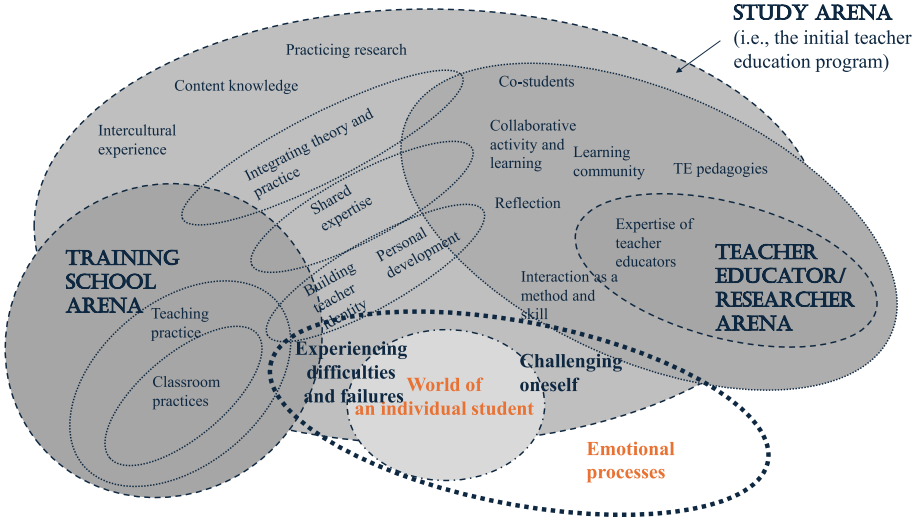


Fig. 7. Social world/arenas map of emotional processes in meaningful learning.

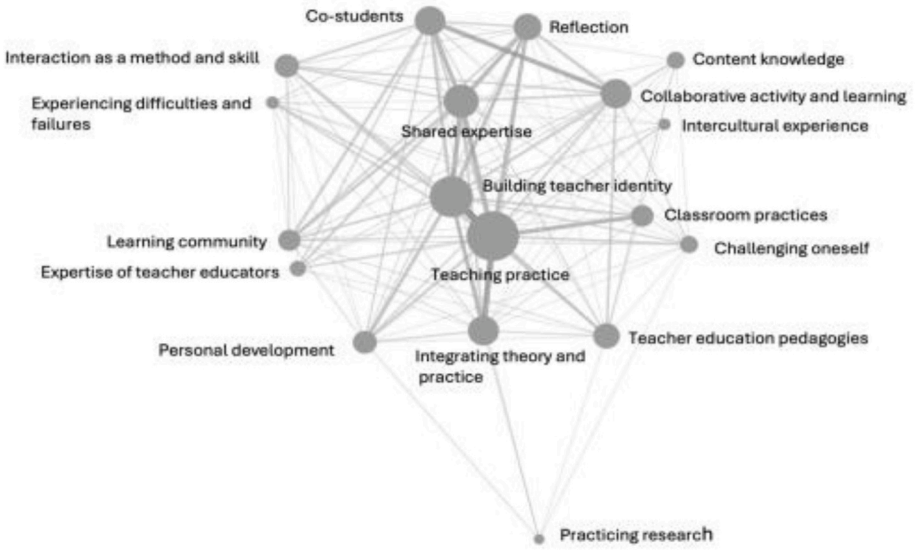


Fig. 8. Relational map of meaningful learning in teacher education.

collaborative activity, and *co-students*. These contexts and processes also formed a close bond with each other. Supporting these six processes and combinations of them in TE seemed to offer a fertile ground for ML. For example, teaching practices encompass several important features of ML. They enable the sharing of expertise with co-students, training school teachers, and teacher educators and allow PSTs to challenge themselves in a safe environment. During teaching practices, theory and practice also combine in a meaningful and appropriate way. This provides material for reflection, and all this together helps build one's teacher identity. The following quote represents the convergence of these different perspectives according to one PST:

> "In groups, discussions, reflections, and guided practices definitely emerge as the most significant methods and experiences during teacher education. Through them, I feel that my thinking and expertise have developed the most. Discussions with other students and teachers have broadened my own perspectives, reflection has clarified them, and in practices, I have been able to try out different approaches in practice with the support of an expert guide." (S25)

Moreover, various collaborative activities with co-students enabled the PSTs to share their expertise and gave them many opportunities to build their teacher identity. Fellow students are equally important as teacher educators when pedagogy provides opportunities for interaction and collaborative activity. This informal learning with fellow students seemed to be just as important as formal learning:

> "The most meaningful experiences for me have been the discussions with other students, both during courses and outside of them. The perspectives presented by others greatly enhance my own learning, and often, co-students have managed to explain difficult concepts in a way that makes them clearer to me. Educational literature plays an important role in providing a foundation for all these discussions." (S50)

6. Discussion

In this study, we investigated what PSTs perceived as meaningful throughout a five-year TE program, aiming to deepen our understanding of how they construct their own learning. The findings reveal that PSTs value learning environments and processes that support authentic, reflective, relational, and emotional engagement. Particularly impactful were teaching practices, pedagogical approaches, and course designs that deliberately integrate theoretical and practical elements (Kostiainen et al., 2018, 2025). Collaborative pedagogies also played a key role in fostering shared expertise, with informal peer discussions emerging as especially meaningful (Korthagen et al., 2006; Loughran, 2006; Timoštšuk & Ugaste, 2010). Together, these experiences contributed to the development of PSTs' teacher identity and strengthened their confidence to enter the profession.

Knowing which processes PSTs consider most meaningful to learning offers both opportunities and challenges for TE. First, our results reveal an emphasis on *authentic processes*. Authentic processes in ML refer to intentionally structured, theory-based instructional approaches that prioritize deep understanding. In TE, these practices are fostered through integrated learning designs, and varied student tasks that bridge the gap between theory and practice, especially practical teaching in the school context. This aligns with previous studies that indicate that practical learning is highly esteemed and that teaching practice is more advantageous than traditional coursework (Bengmark et al., 2024). Our results revealed a slight tension between the training school arena and other study arenas. Notably, an increased focus on practical teaching in schools can enhance the socializing effect of the often traditional school environment on teacher learning (Cherubini, 2009; Tomlinson, 2004). However, our research is also partly in line with a common contradictory view of TE that university courses provide the theory while school practicums offer practical application. This view assumes that teaching expertise is mainly garnered in schools, overlooking valuable university opportunities (Korthagen et al., 2006). Students' reflections often revealed a disconnect between training school activities and other TE. This may stem from differing priorities: schools focus on practical teaching, while universities emphasize theory and research (Vanegas-Ortega & Fuentealba Jara, 2024). Our research also reinforces the idea that training schools and TE programs together form a learning community in PSTs' experiences. These communities provide a safe space for sharing real concerns and emotions rooted in everyday practice; when functioning well, they support affective and motivational needs, enabling effective learning (Korthagen, 2017). To become an expert, one must not only work and gain practical experiences but also intentionally shape and refine those experiences (Bronkhorst et al., 2011). Course designs that enable collaborative learning and critical reflection, as made possible through authentic practices, such as practicum and school projects (Kostiainen & Pöysä-Tarhonen, 2019) are thus important for the development of ML and therefore teacher identity.

Second, our study supports the idea that it is also important to place *reflective processes* at the core of meaningful learning in TE. Reflective processes in ML involve PSTs critically examining their experiences,

thoughts, and actions to deepen understanding and connect theory with practice. Through guided reflection, they reconstruct personal meaning, challenge assumptions, and develop professional identity, making even challenging or emotional experiences transformative. To handle the various situations PSTs will encounter in the school environment, it is crucial for them to have developed adequate reflective skills during their initial TE (Anspal et al., 2011). Reflection is essential for understanding both the theoretical foundations of teaching and classroom practices (Beauchamp, 2015). Through reflection, it is possible to challenge one's everyday thinking and thereby generate ML experiences (Kostiainen & Pöysä-Tarhonen, 2019; Loughran, 2006). However, the emphasis on reflection in TE is often challenging due to the varying interpretations of the concept (Beauchamp, 2015; Korthagen, 2017). While many draw on Dewey's (1910/1991) definition of reflection as "active, persistent, and careful consideration" (p. 6), there is a lack of clear guidelines on how to implement it in practice (Kostiainen et al., 2023). As a result, both students and experienced teachers often perceive reflection as vague or even useless (Akbari, 2007). The task of TE is to assist students in identifying their career aspirations and questioning their preconceived notions about teaching and learning, which are often based on their own school experiences (Anspal et al., 2011). However, the key challenge in TE is how to formulate engaging and appropriately complex questions and problems that emerge from the familiar routines of teaching—questions for which no ready-made answers exist yet. Approaches based on teachers' real concerns and experiences that focus on guided reflection and consider thinking, feeling, and wanting can ease this challenge (Korthagen et al., 2001). As Hanani (2020) argues, one of the main goals of ML is to develop students' critical thinking skills. By creating an environment of equality and trust, ML encourages students to find and present their own solutions to problems in the classroom. This ability is crucial in today's global, competitive world, where creativity and innovation are essential (Hanani, 2020).

Third, relational practices in ML emphasize interaction, collaboration, and emotional sensitivity among teacher educators and PSTs, fostering engagement, pedagogical understanding, and supportive learning communities. From the *relational perspective*, our results align with earlier research that identifies social interaction as one of the most common themes in meaningful and transformational professional development. PSTs in this study emphasized the importance of interacting not only with teacher educators and training school teachers but also with peers (Attebury, 2017; Hagenauer et al., 2024; Michael, 2001). ML and the development of professional identity were supported through peer and faculty discussions (Attebury, 2017; Michael, 2001). These activities facilitate the exchange of knowledge and ideas, benefiting all participants. Moreover, actively creating opportunities for collaborative work (e.g. working in pairs and in small groups, planning and reflecting together, sharing experiences) and peer teaching is one of the most straightforward approaches to stimulate students' discussions (Michael, 2001). Additionally, when PSTs observe teacher educators discussing educational challenges and engage in peer teaching themselves, they begin to see that such complexities are best addressed through dialogue, fostering a critical learning community (Owens, 2014). Accordingly, dialogue within such a community stimulates further thinking (Patton et al., 2013). Although PSTs have a different perspective than their educators, they still need to encounter the tensions, dilemmas, and challenges of practice to learn effectively through experience (Loughran, 2006). In turn, teacher educators must carefully consider their teaching and the reasoning behind it. Teaching about teaching involves revealing the pedagogical reasoning, uncertainties, and challenges of practices (Loughran, 2006). Educators should therefore explicitly verbalize the often implicit knowledge, norms, and values in teaching to enhance PSTs' development (Kostiainen & Pöysä-Tarhonen, 2019).

Fourth, *emotional processes* are associated with nearly all aspects of ML. Emotions play a vital role in ML by influencing cognitive performance, engagement, and the depth of understanding. When PSTs are encouraged to experience and reflect on a wide range of emotions—including discomfort, trust, and wonder—their learning becomes more personal, transformative, and connected to their evolving teacher identity. The results in our study show that almost every thought is influenced by emotions, and when we recall them (e.g., when the PSTs thought about ML experiences), we also remember the emotions associated with them. As we bring back memories of people, places, things, times, and events, each carries its own emotional connection (Ananda, 2023; Dispenza, 2007). In ML, relational and emotional dimensions often overlap—for example, empathy during peer discussions fosters shared emotional understanding (Ananda, 2023; Hagenauer et al., 2024). Teaching practice, group work, and tasks like thesis writing also evoke emotions that challenge students, contributing to ML (Kostiainen et al., 2018; Jakhelln et al., 2019). While earlier studies indicate that teachers' actions are strongly shaped by emotional factors—with emotions having the potential to either obstruct or enhance learning (Korthagen & Evelein, 2016)—it has also become clear that university courses generally lack emotional engagement (Dewey, 2024). Becoming a teacher requires recognizing that some changes are deeply personal (Loughran, 2006) and that understanding oneself also means understanding one's emotional self (Korthagen, 2004).

It is also interesting to consider the contexts and arenas that are not reflected in our results: What is there, what is absent, and what is hidden (Den Outer et al., 2012)? For example, digital learning environments are not at the core of ML in our study. Although online teaching, for instance, can be perceived as meaningful (Kostiainen et al., 2025), the participating PSTs did not rank these processes among the most meaningful in TE. The data was collected between 2018 and 2023, encompassing the period before, during, and after the pandemic. Interestingly, although digital learning environments were extensively used during remote teaching in the pandemic, they did not become central to ML. This result may also reflect the TE program's emphasis on interaction and learning in groups, which makes face-to-face environments more effective. However, TE programs now offer various structures: entirely on-campus, mainly online, hybrid (mixing online and on-campus classes), or blended (online lectures with on-campus seminars; Dyment & Downing, 2020, p. 319). This is a current challenge for TE, indicating a need to develop various online, virtual, and simulated TE learning environments (McGarr, 2020; Näykki et al., 2024; Teo et al., 2021).

Finally, what do we want our students to achieve with the ML that they acquire? As Feiman-Nemser (2001) aptly writes, "what students learn is directly related to what and how teachers teach" (p. 1013), that is, we expect them to be able to apply what they know about learning to novel situations. When they can do this, we consider that they truly "understand" what is to be learned. This study revealed and made visible many connections as experienced by the included PSTs that produce ML. ML can be the result of the interaction of one or more processes. Understanding this as teacher educators, our goal must be to design and validate learning resources and environments that help students learn to be teachers meaningfully and learn education processes with understanding.

7. Limitations and further research

This study looked at PSTs' reflections at the end of their studies. There are several limitations to be considered when interpreting the results of this study. While this study focuses on formal TE, learning extends beyond institutions and guided instruction—people learn continuously through diverse life contexts and practices (Erstad & Sefton-Green, 2013; Esteban-Guitart, 2016). Moreover, through digital technologies, individuals can better access, create, and share information and knowledge, making education a distributed activity across multiple settings and involving diverse potential educators. Indeed, digital technologies enable teaching and learning to take place anywhere at any time (Esteban-Guitart et al., 2017). It is also important to understand the meaningful informal experiences PSTs have—where

they happen, who they involve—as these can significantly support professional development. In this study, for example, the involved PSTs specifically mentioned informal learning environments as conversations with fellow students.

Our research highlights the importance of emotional processes in ML. Previous studies show that student-teachers in arts-based courses experience a wide range of emotions, from fear and anxiety to excitement and joy (Møller-Skau & Lindstøl, 2022). Further research is needed to explore the ML experiences provided by arts-based methods in TE (Martin & Kostiainen, 2024).

Our results are also shaped by the cultural context in which the data was collected. We must consider how our roles as teacher educators within this specific TE program may have influenced our interpretation of the data, the construction of the arenas, or the emphasis on certain themes. For example, in the Finnish TE context studied, interaction is emphasized both as a phenomenon of study in the curriculum and as a pedagogical method. The curriculum emphasizes interaction skills and learning methods highlight peer and group learning. This must be taken into account when interpreting the results, especially when interpreting the manifestation of relational processes in ML. Thus, we as teacher educator and education researchers have to critically reflect on our own influence on the research process as well. When examining TE from the inside as we did, the elements of the social world/arenas map can be positioned differently than if it was viewed from the outside. Still, familiarity with TE helped us to understand the more subtle relationships between different elements of ML. Also, visual analysis is often influenced by the researcher's own biases, perspectives, and experiences (Bresciani & Eppler, 2015). This subjectivity can lead to different interpretations of the same visual data.

The data were collected through written reflections. Interviews with the graduating students could have provided deeper insights into the reasons why certain experiences, environments, or processes become meaningful to them. Additionally, one indicator of the meaningfulness of TE is alumni's perceptions of which aspects of the TE continue to be meaningful in their professional lives (Bengmark et al., 2024; Mäkinen et al., 2024).

It would also be valuable to examine which learning experiences in TE diminish student-teachers' enthusiasm and why they are perceived as least meaningful (Piercy et al., 2016). Understanding these aspects can provide other critical insights into improving TE programs.

8. Theoretical and educational significance of the study

This research provides at least a partial answer to the question of what needs to be done to help PSTs learn with understanding. Further, the research provides a more comprehensive understanding of the ML generated by the entire TE program. ML experiences have great potential to transform and challenge PSTs' existing, often simplistic, conceptions of teaching and learning (Loughran, 2006). Accordingly, TE that promotes ML can provide students possibilities to explore new ideas and inspirations, allowing them to test and practice these in authentic contexts. As TE is not a sector isolated from its surroundings, understanding PSTs' experiences of meaningful learning in TE is central to developing emotionally, relationally, and morally sound pedagogical practices that resonate with the actual problems faced in education and greater society (Kostiainen & Pöysä-Tarhonen, 2019).

Previous studies indicate that many newly qualified teachers feel unprepared for the demands of their profession (Bezzina, 2007). This is particularly true in research-oriented TE, where translating research into practice poses challenges (Hansén et al., 2015; Jakhelln et al., 2019). Bridging the gap between theory and practice remains a major challenge, placing significant responsibility on teacher educators to integrate research in ways PSTs find relevant (Bengmark et al., 2024). Our study shows that ML, especially through authentic practices and reflective processes, can help integrate theory and practice. In discussions, PSTs engage in "talking teacherhood," exchanging ideas about teaching and learning with peers and educators (Michael, 2001, p. 152). When genuine problems are reflected upon collaboratively, theory and practice merge meaningfully. Student-driven topics also generate active processes that demand theoretical understanding grounded in practical problems.

Both teacher educators and PSTs need to develop a scientific understanding of learning concepts, as the research behind these concepts explains how ML takes place (Ananda, 2023). Deeper understanding of these concepts enables teacher educators specifically to design effective instructional practices that enhance the richness and relevance of learning. However, crucial to the further development of learning methods and designs is the central role of co-students.

According to our review of TE research, this study is among the first to employ SA. Methodologically, it also advocates for using SA to examine complex systems. A key strength of the social world/arenas framework within SA lies in its conceptual flexibility, allowing for analysis at various levels of complexity (Clarke & Star, 2008). Furthermore, it offers processual concepts with which negotiations, controversies, and other forms of collective action can be examined (Offenberger et al., 2023). The social world/arenas framework also provides an adaptable research approach for analyzing, mapping, and visualizing the complex and dynamic processes of meaningful learning in TE (Clarke, 2005; Clarke & Friese, 2007; Clarke & Star, 2008; Offenberger et al., 2023). Visual maps illustrate the complex interactions between multiple variables simultaneously (Clarke & Friese, 2007), helping us understand how different factors influence one another in a given context, which might be difficult to capture through thematic analysis alone. These representations offer a holistic view of the data, making it easier to identify overarching themes and connections. They are particularly useful for synthesizing large volumes of qualitative data and presenting them in an accessible format. For example, SA revealed a deeper dimension of collaboration and relationality. This sense of community is built by the training school teachers, teacher educators and fellow TE students. Such insights can inform the development of TE. In addition, the broad and layered meaning of reflection became apparent: PSTs reflect not only in formal learning activities but especially with peers in both formal and informal contexts. In this reflexive research, we viewed the situational map as a presentation of what we perceive to exist, while the social world/arenas map was a representation that categorized subsets of ML into distinct worlds (Den Outer et al., 2012, p. 1517).

Further, the research provides a more comprehensive understanding of the ML generated by the entire TE program. The added value of this study does not lie primarily in the methodological novelty of applying SA, but rather in its longitudinal and holistic research design, which allowed for the exploration of students' experiences over the full course of the program.

CRediT authorship contribution statement

Emma Kostiainen: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Johanna Pöysä-Tarhonen:** Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

We imply that the work described has not been published previously and it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder.

Data availability

Data will be made available on request.

References

Aarto-Pesonen, L., & Piirainen, A. (2019). Teacher students' meaningful learning in widening learning worlds. *Teaching Education, 31*(3), 323–342. https://doi.org/10.1080/10476210.2018.1561662

Ahmady, S., & Khani, H. (2022). The situational analysis of teaching-learning in clinical education in Iran: A postmodern grounded theory study. *BMC Medical Education, 22* (520). https://doi.org/10.1186/s12909-022-03577-3

Akbari, R. (2007). Reflections on reflection: A critical appraisal of reflective practices in L2 teacher education. *System, 35*(2), 192–207. https://doi.org/10.1016/j.system.2006.12.008

Ananda, K. A. (2023). Perspective chapter: Emotive cognition strategies on enhancing meaningful learning among undergraduate student-teachers. In D. Ortega-Sánchez (Ed.), *Education annual volume 2023*. IntechOpen. https://doi.org/10.5772/intechopen.111885.

Andrews, D., Van Lieshout, E., & Kaudal, B. B. (2023). How, where, and when do students experience meaningful learning? *International Journal of Innovative Science and Modern Engineering, 31*(3), 28–45. https://doi.org/10.30722/IJISME.31.03.003

Anspal, T., Eisenschmidt, E., & Löfström, E. (2011). Finding myself as a teacher: Exploring the shaping of teacher identities through student teachers' narratives. *Teachers and Teaching, 18*(2), 197–216. https://doi.org/10.1080/13540602.2012.632268

ATLAS.ti. (n.d.). ATLAS.ti manual (mac). Retrieved June 18, 2025, from https://manuals.atlasti.com/Mac/en/manual/ATLAS.ti_ManualMac.pdf.

Attebury, R. I. (2017). Professional development: A qualitative study of high impact characteristics affecting meaningful and transformational learning. *The Journal of Academic Librarianship, 43*(3), 232–241. https://doi.org/10.1016/j.acalib.2017.02.015

Ball, D. L., & Forzani, M. F. (2009). The work of teaching and the challenge for teacher education. *Journal of Teacher Education, 60*(5), 497–511. https://doi.org/10.1177/0022487109348479

Barnett, R. (2000). Supercomplexity and the curriculum. *Studies in Higher Education, 25* (3), 255–265. https://doi.org/10.1080/713696156

Beauchamp, C. (2015). Reflection in teacher education: Issues emerging from a review of current literature. *Reflective Practice, 16*(1), 123–141. https://doi.org/10.1080/14623943.2014.982525

Bengmark, S., Fainsilber, L., & Gustafsson, T. (2024). What graduates want in teacher education. *Scandinavian Journal of Educational Research, 69*(3), 1–13. https://doi.org/10.1080/00313831.2024.2318651

Benner, P. (2012). Educating nurses: A call for radical transformation. How far have we come? *Journal of Nursing Education, 51*(4), 183–184. https://doi.org/10.3928/01484834-20120402-01

Bezzina, C. (2007). Beginning teachers' perceptions about their induction in Malta. In M. Z. Zuljan, & J. Vogrinc (Eds.), *Professional inductions of teachers in Europe and elsewhere* (pp. 260–279). University of Ljubljana, Faculty of Education.

Bresciani, S., & Eppler, M. J. (2015). The pitfalls of visual representations: A review and classification of common errors made while designing and interpreting visualizations. *Sage Open, 5*(4). https://doi.org/10.1177/2158244015611451

Bretz, S. L., Fay, M., Bruck, L. B., & Towns, M. H. (2013). What faculty interviews reveal about meaningful learning in the undergraduate chemistry laboratory. *Journal of Chemical Education, 90*, 281–288. https://doi.org/10.1021/ed300384r

Bronkhorst, L. H., Meijer, P. C., Koster, B., & Vermunt, J. D. (2011). Fostering meaning-oriented learning and deliberate practice in teacher education. *Teaching and Teacher Education, 27*(7), 1120–1130. https://doi.org/10.1016/j.tate.2011.05.008

Cherubini, L. (2009). Reconciling the tensions of new teachers' socialisation into school culture: A review of the research. *Issues in Educational Research, 19*, 83–99. http://www.iier.org.au/iier19/cherubini.html.

Clarke, A. (2005). *Situational analysis: Grounded theory after the postmodern turn*. Sage.

Clarke, A., & Friese, C. (2007). Grounded theorizing using situational analysis. In A. Bryant, & K. Charmaz (Eds.), *The SAGE handbook of grounded theory* (pp. 363–397). Sage.

Clarke, D., & Hollingsworth, H. (2002). Elaborating a model of teacher professional growth. *Teaching and Teacher Education, 18*, 947–967. https://doi.org/10.1016/S0742-051X(02)00053-7

Clarke, A. E., & Star, S. L. (2008). The social worlds framework: A theory/methods package. In E. J. Hackett, O. Amsterdamska, M. Lynch, & J. Wajcman (Eds.), *Science and technology studies handbook* (pp. 113–137). MIT Press.

Clarke, A. E., Washburn, R., & Friese, C. (2022). *Situational analysis in practice: Mapping relationalities across disciplines* (2nd ed.). Routledge.

Darling-Hammond, L., & Snyder, J. (2000). Authentic assessment of teaching in context. *Teaching and Teacher Education, 16*(5–6), 523–545. https://doi.org/10.1016/S0742-051X(00)00015-9

Daves, D. P., & Roberts, J. G. (2010). Online teacher education programs: Social connectedness and the learning experience. *Journal of Instructional Psychology, 4*, 1–9.

Den Outer, B., Handley, K., & Price, M. (2012). Situational analysis and mapping for use in education research: A reflexive methodology? *Studies in Higher Education, 38*(10), 1504–1521. https://doi.org/10.1080/03075079.2011.641527

Dewey, J. (1991). *How we think*. Prometheus Books (Original work published 1910).

Dewey, J. (2024). *Democracy and education*. Columbia University Press.

Dispenza, J. D. C. (2007). *Evolve your brain*. Health Communications, Inc.

Dyment, J. E., & Downing, J. J. (2020). Online initial teacher education: A systematic review of the literature. *Asia-Pacific Journal of Teacher Education, 48*(3), 316–333. https://doi.org/10.1080/1359866X.2019.1631254

Edwards, A., & D'Arcy, C. (2004). Relational agency and disposition in sociocultural accounts of learning to teach. *Educational Review, 56*(2), 147–155. https://doi.org/10.1080/0031910410001693236

Erstad, O., & Sefton-Green, S. (Eds.). (2013). *Identity, community, and learning lives in the digital age*. Cambridge University Press.

Esteban-Guitart, M. (2016). *Funds of identity. Connecting meaningful learning experiences in and out of school*. Cambridge University Press.

Esteban-Guitart, M., Serra, J. M., & Vila, I. (2017). Informationalism and informalization of learnings in 21st century. A qualitative study on meaningful learning experiences. *Social and Education History, 6*(1), 1–25. https://doi.org/10.17583/hse.2017.2111

Feiman-Nemser, S. (2001). From preparation to practice: Designing a continuum to strengthen and sustain teaching. *Teachers College Record, 103*(6), 1013–1055. https://doi.org/10.1111/0161-4681.00141

Friese, S. (2014). *Qualitative data analysis with Atlas.ti*. Sage.

Hagenauer, G., Raufelder, D., Ivanova, M., Bach, A., & Ittner, D. (2024). The quality of social relationships with students, mentor teachers and fellow student teachers and their role in the development of student teachers' emotions in the practicum. *European Journal of Psychology of Education, 39*, 4067–4089. https://doi.org/10.1007/s10212-024-00847-0

Hanani, N. (2020). Meaningful learning reconstruction for millennial: Facing competition in the information technology era. *IOP Conference Series: Earth and Environmental Science, 469*(1), Article 012107. https://doi.org/10.1088/1755-1315/469/1/012107

Hansén, S.-E., Eklund, G., & Sjöberg, J. (2015). General didactics in Finnish teacher education – The case of class teacher education at Åbo Akademi University. *Nordisk Tidskrift För Allmän Didaktik, 1*(1), 7–20. https://doi.org/10.57126/noad.v1i1.13141

Jakhelln, R., Eklund, G., Aspfors, J., Bjørndal, K., & Stølen, G. (2019). Newly qualified teachers' understandings of research-based teacher education practices—two cases from Finland and Norway. *Scandinavian Journal of Educational Research, 65*(1), 123–139. https://doi.org/10.1080/00313831.2019.1659402

Jonassen, D. H., & Strobel, J. (2006). Modeling for meaningful learning. In D. Hung, & M. S. Khine (Eds.), *Engaged learning with emerging technologies* (pp. 1–27). Springer. https://doi.org/10.1007/1-4020-3669-8_1.

Karpicke, J. D., & Grimaldi, P. J. (2012). Retrieval-based learning: A perspective for enhancing meaningful learning. *Educational Psychology Review, 24*, 401–418. https://doi.org/10.1007/s10648-012-9202-2

Körkkö, M. (2019). Towards meaningful reflection and a holistic approach: Creating a reflection framework in teacher education. *Scandinavian Journal of Educational Research, 65*(2), 258–275. https://doi.org/10.1080/00313831.2019.1676306

Korthagen, F. (2004). In search of the essence of a good teacher: Towards a more holistic approach in teacher education. *Teaching and Teacher Education, 20*(1), 77–97. https://doi.org/10.1016/j.tate.2003.10.002

Korthagen, F. (2017). Inconvenient truths about teacher learning: Towards professional development 3.0. *Teachers and Teaching: Theory and Practice, 23*(4), 387–405. https://doi.org/10.1080/13540602.2016.1211523

Korthagen, F., & Evelein, F. G. (2016). Relations between student teachers' basic needs fulfillment and their teaching behavior. *Teaching and Teacher Education, 60*, 234–244. https://doi.org/10.1016/j.tate.2016.08.021

Korthagen, F., Kessels, J., Koster, B., Lagerwerf, B., & Wubbels, T. (2001). *Linking practice and theory: The pedagogy of realistic teacher education*. Lawrence Erlbaum Associates.

Korthagen, F., Loughran, J., & Russell, T. (2006). Developing fundamental principles for teacher education programs and practices. *Teaching and Teacher Education, 22*(8), 1020–1041. https://doi.org/10.1016/j.tate.2006.04.022

Kostiainen, E., Aalto, E., Hiljanen, M., & Tallavaara, R. (2023). Opettajaopiskelijoiden reflektointiosaamisen kehittäminen [developing student teachers' reflection skills]. *Yliopistopedagogiikka, 30*(1). https://lehti.yliopistopedagogiikka.fi/2023/06/22/opettajaopiskelijoiden-reflektointiosaamisen-kehittaminen/.

Kostiainen, E., Nousiainen, T., & Näykki, P. (2025). From a bitter start to meaningful learning in online teacher education. *Scandinavian Journal of Educational Research*, 1–18. https://doi.org/10.1080/00313831.2025.2459404

Kostiainen, E., & Pöysä-Tarhonen, J. (2019). Meaningful learning in teacher education, characteristics of. In M. A. Peters (Ed.), *Encyclopedia of teacher education* (pp. 1–6). Springer. https://doi.org/10.1007/978-981-13-1179-6_50-1.

Kostiainen, E., Ukskoski, T., Ruohotie-Lyhty, M., Kauppinen, M., Kainulainen, J., & Mäkinen, T. (2018). Meaningful learning in teacher education. *Teaching and Teacher Education, 71*, 66–77. https://doi.org/10.1016/j.tate.2017.12.009

Lanier, J., & Little, J. W. (1986). Research in teacher education. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 527–560). MacMillan.

Lehtinen, A., Kostiainen, E., & Näykki, P. (2023). Co-construction of knowledge and socioemotional interaction in pre-service teachers' video-based online collaborative learning. *Teaching and Teacher Education, 133*, Article 104299. https://doi.org/10.1016/j.tate.2023.104299

Lofthouse, R., Greenway, C., Davies, P., Davies, D., & Lundholm, C. (2020). Pre-service teachers' conceptions of their own learning: Does context make a difference? *Research Papers in Education, 36*(6), 682–703. https://doi.org/10.1080/02671522.2020.1767181

Loughran, J. J. (2002). Effective reflective practice. In search of meaning in learning about teaching. *Journal of Teacher Education, 53*(1), 33–43. https://doi.org/10.1177/0022487102053001004

Loughran, J. J. (2006). *Developing a pedagogy of teacher education. Understanding teaching and learning about teaching*. Routledge.

Mäkinen, T., Kostiainen, E., & Klemola, U. (2022). Significant in life: Core learning outcomes of a social and emotional course in physical education teacher education. In M. Talvio, & K. Lonka (Eds.), *International approaches to promoting social and emotional learning in schools: A framework for developing teaching strategy* (pp. 167–189). Routledge. https://doi.org/10.4324/9781003093053-13.

Mäkinen, T., Virtanen, A., & Kostiainen, E. (2024). Social and emotional learning in Finnish physical education teacher education. *Journal of Teaching in Physical Education, Early Online*. https://doi.org/10.1123/jtpe.2024-0120

Martin, A., & Kostiainen, E. (2024). Narrating teachers' professional development: Arts-based creative expression in educational research. In E. K. Hyry-Beihammer, O. Ylitapio-Mäntylä, & M. Uitto (Eds.), *Narratives in educational research: Methodological perspectives* (pp. 137–157). Springer. https://doi.org/10.1007/978-3-031-68350-3_9.

McGarr, O. (2020). The use of virtual simulations in teacher education to develop pre-service teachers' behaviour and classroom management skills: Implications for reflective practice. *Journal of Education for Teaching, 47*(2), 274–286. https://doi.org/10.1080/02607476.2020.1733398

McGarr, O., O'Grady, E., & Guilfoyle, L. (2016). Exploring the theory-practice gap in initial teacher education: Moving beyond questions of relevance to issues of power and authority. *Journal of Education for Teaching, 43*(1), 48–60. https://doi.org/10.1080/02607476.2017.1256040

Michael, J. (2001). In pursuit of meaningful learning. *Advances in Physiology Education, 25*(3), 145–158. https://doi.org/10.1152/advances.2001.25.3.145

Møller-Skau, M., & Lindstøl, F. (2022). Arts-based teaching and learning in teacher education: "Crystallising" student teachers' learning outcomes through a systematic literature review. *Teaching and Teacher Education, 109*, Article 103545. https://doi.org/10.1016/j.tate.2021.103545

Näykki, P., Pyykkönen, S., Latva-Aho, J., Nousiainen, T., Ahlström, E., & Toivanen, T. (2024). Pre-service teachers' collaborative learning and role-based drama activity in a virtual reality environment. *Journal of Computer Assisted Learning, 40*(6), 3264–3277. https://doi.org/10.1111/jcal.13079

Niemi, H., & Jakku-Sihvonen, R. (2011). Teacher education in Finland. In M. V. Zuljan, & J. Vogrinc (Eds.), *European dimensions of teacher education – Similarities and differences* (pp. 33–52). University of Ljubljana.

Offenberger, U., Baumgartner, R., Schwertel, T., Tietje, O., Evans-Jordan, S. B., & Kimmerle, B. (2023). Editorial: Social worlds, arenas, and situational analyses: Theoretical debates and experiences from research practice. *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research, 24*(2). https://doi.org/10.17169/fqs-24.2.4085. Article 14.

Okukawa, H. (2008). If your learning experience is meaningful for you, how have you been constructing that meaning? A study of adult learners in Bangkok. *International Forum of Teaching and Studies, 4*(1), 46–61.

Patton, K., Parker, M., & Pratt, E. (2013). Meaningful learning in professional development: Teaching without telling. *Journal of Teaching in Physical Education, 32*, 441–459. https://doi.org/10.1123/jtpe.32.4.441

Pekrun, R. (2014). *Emotions and learning (Educational practices series, 24)*. UNESCO International Bureau of Education.

Perlman, C., Weston, C., & Gisel, E. (2010). Enabling meaningful learning through web-based instruction with occupational therapy students. *Educational Technology Research & Development, 58*, 191–210. https://doi.org/10.1007/s11423-008-9097-2

Piercy, F. P., Earl, R. M., Aldrich, R. K., Nguyen, H. N., Steelman, S. M., Haugen, E., Riger, D., Tsokodayui, R. T., West, J., Keskin, Y., & Gary, E. (2016). Most and least meaningful learning experiences in marriage and family therapy education. *Journal of Marital and Family Therapy, 42*(4), 584–598. https://doi.org/10.1111/jmft.12176

Slade, M. L., Burnham, T. J., Catalana, S. M., & Waters, T. (2019). The impact of reflective practice on teacher candidates' learning. *International Journal for the Scholarship of Teaching & Learning, 13*(2). https://doi.org/10.20429/ijsotl.2019.130215. Article 15.

Su, Y. H. (2011). The constitution of agency in developing lifelong learning ability: The "being" mode. *Higher Education, 62*, 399–412. https://doi.org/10.1007/s10734-010-9395-6

Taxer, J. L., & Frenzel, A. C. (2015). Facets of teachers' emotional lives: A quantitative investigation of teachers' genuine, faked, and hidden emotions. *Teaching and Teacher Education, 49*, 78–88.

Teo, T., Unwin, S., Scherer, R., & Gardiner, V. (2021). Initial teacher training for twenty-first century skills in the fourth industrial revolution (IR 4.0): A scoping review. *Computers & Education, 170*, Article 104223. https://doi.org/10.1016/j.compedu.2021.104223

Timoštšuk, I., & Ugaste, A. (2010). Student teachers' professional identity. *Teaching and Teacher Education, 26*(8), 1563–1570. https://doi.org/10.1016/j.tate.2010.06.008

Tomlinson, H. (2004). *Educational leadership*. Sage.

Toom, A., Husu, J., & Patrikainen, S. (2015). Student teachers' patterns of reflection in the context of teaching practice. *European Journal of Teacher Education, 38*(3), 320–340. https://doi.org/10.1080/02619768.2014.943731

Valli, R., Valli, P., & Lähdesmäki, S. (2017). Meaningful learning experiences in the Finnish teacher education. *Asian Journal of Education and e-learning, 5*(2), 27–35. https://doi.org/10.24203/ajeel.v5i2.4471

Vanegas-Ortega, C., & Fuentealba, J. R. (2024). Teacher education during the COVID-19 pandemic: Tensions and challenges of initial teacher training practices. *Education Sciences, 14*(7), 794. https://doi.org/10.3390/educsci14070794

Vargas-Hernández, J. G., & Vargas-González, O. C. (2022). Strategies for meaningful learning in higher education. *Journal of Research in Instructional, 2*(1), 47–64. https://doi.org/10.30862/jri.v2i1.41

Whitney, L., Golez, F., Nagel, G., Nieto, C., & Nieto, C. (2002). Listening to voices of practicing teachers to examine the effectiveness of a teacher education program. *Action in Teacher Education, 23*(4), 69–76. https://doi.org/10.1080/01626620.2002.10463090

Yeigh, T., & Lynch, D. (2017). Reforming initial teacher education: A call for innovation. *Australian Journal of Teacher Education, 42*(12), 112–127. https://doi.org/10.14221/ajte.2017v42n12.7