CURRENT ISSUES IN TEACHER TRAINING

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Foreword

Changes in the demographic structures of countries, socio-economic developments, and the search for innovations required by the age make it necessary for the teacher education process to be continuously reviewed and improved. In this context, the content of teacher-education programs, as well as the principles on which they are based, must be updated and revised institutionally to ensure their effective implementation. This book has been prepared in response to this need, with the expectation that several fundamental issues—whose reconsideration is essential in nearly all teacher-training programs—will be brought back into focus. In this respect, the opening chapter establishes the philosophical foundation of this volume by introducing the concept of worldview and outlining its principal classifications. By examining the naturalist worldview underlying modern science, it invites readers to reflect on the epistemological assumptions that shape contemporary educational practices. The chapter situates worldviews within learning environments and instructional decision-making, demonstrating that teaching is not merely technical but deeply value-laden. It concludes by offering concrete recommendations for preparing future teachers to recognize, interrogate, and responsibly navigate worldview issues as part of their professional formation.

Building on this conceptual grounding, the second chapter turns to the rapidly transforming landscape of the 21st century and the corresponding need for new learning skills. It critically examines the limitations of traditional learning approaches in a world marked by globalization, digitalization, and a knowledge-driven economy. Central competencies—critical thinking, problem-solving, communication, collaboration, and digital literacy—are explored in depth alongside strategies for cultivating them in children. By emphasizing creativity, innovation, experiential learning, and self-directed lifelong learning, the chapter presents a comprehensive framework of 21st-century skills essential for learners' success in education, work, and civic life.

The third chapter shifts focus to sustainability, detailing the principles of sustainable development and interpreting the 2030 UN Sustainable Development Goals through an educational lens. It positions education as a transdisciplinary endeavor, illustrated through practices such as Eco-Schools and Green Campus initiatives that model sustainability in institutional life. By linking sustainable development with environmental and climate change education, the chapter underscores the pivotal role of teacher training programs in equipping educators to foster environmental awareness, responsibility, and global citizenship.

Socio-Scientific Issues (SSI) serve as the focus of Chapter 4, introduced as an integrative framework connecting scientific knowledge with its ethical, political, and social implications. The chapter traces the theoretical roots of SSI and situates them within contemporary understandings of scientific literacy. It evaluates the pedagogical potential of SSI—particularly in cultivating argumentation, ethical reasoning, critical thinking, and democratic participation—and reviews instructional models such as Sadler's SSI Teaching Framework and the SSI-5E Model. Classroom scenarios further illustrate how SSI-based instruction promotes engagement and responsible decision-making. The chapter ultimately argues for embedding SSI deeply within teacher education to prepare educators for complex societal challenges.

Chapter 5 explores the accelerating evolution of educational technologies, highlighting how tools once considered innovative have quickly become traditional. It examines the transformative potential of artificial intelligence for teachers, learners, and administrators while acknowledging the systemic and individual dimensions of educational technology. The chapter offers a balanced perspective by emphasizing both the substantial pedagogical benefits and the emerging risks—including ethical dilemmas—associated with widespread technology adoption in schools.

The sixth chapter focuses on teacher training in distance education, presenting a nuanced analysis of its opportunities and challenges. It discusses the technological infrastructures and pedagogical models shaping remote teacher preparation, alongside the competencies required of academic staff working in online environments. By outlining forward-looking recommendations, the chapter provides a strategic roadmap for enhancing the quality, accessibility, and sustainability of teacher education through digital modalities.

Chapter 7 examines the foundational concepts of measurement, assessment, and evaluation, clarifying their roles in educational processes. It outlines the assessment competencies expected of pre-service teachers and details how assessment practices—supported increasingly by educational technologies—are integrated into teacher education programs. The chapter also addresses ethical considerations and future trends in assessment, highlighting the need for fairness, transparency, and data literacy in modern educational evaluation.

The eighth chapter offers a compelling portrait of novice teachers' early professional experiences, revealing the tension between idealistic expectations and classroom realities. By reconceptualizing praxis shock as an extended and multifaceted challenge, the chapter analyzes institutional, curricular, relational, and personal contributors to new teachers' struggles. It

emphasizes the critical role of mentorship, reflective practice, and professional learning communities in supporting beginning teachers. The chapter concludes with a call to reimagine teacher education through stronger school partnerships, more authentic practicum experiences, and deeper attention to teacher identity formation.

Focusing on Türkiye, Chapter 9 traces a century-long evolution of teacher education from Darülmuallimîn to the emerging National Education Academy. Despite ongoing reforms, the chapter identifies persistent challenges such as policy discontinuity, limited practice opportunities, and declining teacher motivation. Drawing comparisons with Finland, Singapore, and Germany, it highlights the importance of selective admission, structured mentoring, and practice-based training for developing high-quality teachers. The chapter argues that the National Education Academy represents a significant paradigm shift that must be accompanied by sustained policy coherence, international collaboration, and robust lifelong professional development.

The final chapter centers on the role of accreditation in teacher training programs, examining its historical development and current practices at both local and global levels. It outlines the core components of effective accreditation systems and discusses their implications for program quality and accountability. By addressing the challenges and policy-practice tensions inherent in accreditation processes, the chapter provides a forward-looking perspective on how accreditation can strengthen teacher education and ensure alignment with evolving global standards.

Halil TURGUT

Özkan AKMAN

Ahmet ÖNAL

CHAPTER 1

Worldview Education in Teacher Training Programs

Halil TURGUT

Chapter Highlights

- The concept of worldview and its classifications were introduced.
- The naturalist worldview basis of modern science was discussed.
- The place and role of worldviews in education in the context of learning environments and teaching practices were viewed.
- Suggestions have been made for the training process of future teachers on worldview issues.

Introduction

The human life, between birth and death, is a journey filled with problems, solutions, and choices. Central to this journey is the individual's quest for self-actualization, and this quest, with its cognitive, affective, and moral dimensions, has formed the focus of a number of developmental theories. A holistic view of these theories reveals that their goal is to understand human actions and the factors that guide them. While the answer is multifaceted and complex, the question being pursued is simply how human beings make decisions and shape their actions, leading us to the concept of worldview. Whether profound and developed or implicit and naive, every human being possesses a specific worldview, woven from beliefs, assumptions, and values regarding existence, existence itself, and their place and meaning within it. This worldview shapes how human beings interact with their environment and the worlds of existence, their reactions to any action, the decisions they make, and the judgments they form. For example, in the following scenario, the judgments and reasons given about the protagonist of the story are a matter of worldview:

> *"A man whose wife has a terminal illness has no money to buy the medication she needs. The medication is very expensive, and no one around him will lend him the money. He visits every pharmacy, explaining his situation, begging, and promising to repay the debt if they give him the medication, but none of them accept. So one*

night, he breaks into one of the pharmacies and steals the medication he needs (Slavin, 2006).”

In this scenario, there is a search for an answer that cannot be limited to a moral judgment or a simple mathematical equation, pitting values against each other. This search requires an inquiry into the meaning of life, good, evil, responsibility, cooperation, and individual rights, and, prior to this, an awareness of the concept of worldview and the ways of knowing that inform worldviews. Therefore, developing such an awareness and supporting the cognitive, affective, and moral development that will liberate individuals and help them make informed decisions is crucial. With this understanding, the subject of this section is the concept of worldview, and the theoretical foundations and skills that teachers, who should play an important role in raising individuals' awareness of their worldviews, must have to enter the profession prepared for this role are discussed in the context of teacher training programs.

1. The Concept of Worldview

Despite its widespread use, the concept of worldview is not unequivocally defined and has been addressed in various ways by many researchers since Kant's early term "weltanschauung" (Flanagan, 2021). Definitions such as mental map (Lappe, Lappe, 2003), meaning-overarching philosophy (Samovar, Porter, 2004), and framework for making sense of the world (Aerts et al., 1994) can be considered examples in this regard. Simply, a worldview is a set of beliefs, opinions, values, and principles that enable individuals to understand the nature of reality, their own position in the universe (Ansari, Kant, 2024) and facilitates grasping the essence of natural and social events, developing attitudes toward phenomena, attributing purpose and meaning to life, and acquiring knowledge of environmental events (Paridinova et al., 2023). It creates a non-rational foundation for thoughts, emotions, and behavior and provides presuppositions about how the outside world really is and how valid and reliable information of that world can be obtained (Cobern, 1996).

Although this foundation is nonrational, it determines individuals’ assumptions about the reality and directly influences their mental processes, focused questions, and conclusions (Tsbulsky, Levin, 2019). As stated above, it guides individuals’ mental world, emotions, and behaviors by providing presuppositions about the nature of reality and the valid sources that provide

knowledge of it (Cobern, 1996). Furthermore, it provides the basis for understanding the contexts in which identities develop (Koltko-Rivera, 2004) and the paradigms that shape cultures and thought (Hiebert, 2008). Therefore, it provides the opportunity to grasp both the presuppositions that form individuals' identity and the cultural context that shapes these presuppositions.

The presuppositions that constitute individuals' worldviews have an interpretive structure and constitute a highly stable and deeply rooted set, yet they are also open to change and evolutionary transformation (Cobern et al., 1990). This deeply rooted set shapes the individual's self-definition, their answer to the question "Who am I?", their norms, their relationships with other domains of existence, and their concepts of the universe and time (Kraft, 1978). Thus, as a culturally organized set of macro-ideas, they determine individuals' symbolic creations, and ethno-philosophies (Kearney, 1984) as well as enabling them to make sense of life (Kawagley et al., 1998) and shaping important cognitive processes such as learning, information processing, and decision-making (Sodowsky et al., 1994).

Within such a perspective, it can be argued that worldview actually represents a metaphysical structure that shapes an individual's perception of reality and plays a decisive role in their choices regarding ways of knowing and sources of information (Cobern, 1996). Because, in the background of each way knowing there are some basic assumptions and a metaphysical dimension that make it specific. For an individual to choose a particular way of knowing, the fundamental assumptions of their worldview and the way of knowing must align, or at least not contradict. For example, an individual who adopts a worldview that prioritizes science as a way of knowing and the sources of knowledge it envisions should value empirical data and factual realities. On the other hand, individuals may also consult sources of information such as sensory experience, reason, revelation, authority, tradition, analogies, aesthetics, etc. when seeking answers to multifaceted and complex questions, and often do not settle for a single source of information (Elkana, 1981). So, individuals, along with the aesthetic and religious motifs that shape their perceptions of the universe, can also seek answers to big questions under the guidance of different ways of knowing, beyond the metaphysical assumptions of modern science (Smolicz, Nunan, 1975). In such a case, the worldview also creates a perspective that provides insight into how different sources of information can be used in different situations (Cobern, 1996).

Worldview is much more than simply a set of beliefs; it actually refers to a system of beliefs that are systematically and structurally related to each other (Naugle, 2002). This system of

beliefs is based on an understanding of multiple worlds, encompassing physical entities, mental and psychological processes, and those produced by mental processes (Popper, 1979), and therefore should be evaluated holistically. However, it may not always be possible to say that individuals who share the same systematic and holistic belief system will reach the same conclusions on all issues, or that two individuals who reach the same conclusions have a common worldview (Tsbulsky, Levin, 2019). So, to summarize briefly, the following four aspects should be noticed in the worldview discussions (Ansari, Kant, 2024): (i) every individual has a worldview whether they are aware of it or not (CoRE, 2018; van der Kooij et al., 2013), (ii) a worldview can be religious, secular or eclectic (CoRE, 2018; Miedema, 2017), (iii) worldview is related to the cultural environment in which the individual lives and (iv) since worldview includes values and norms, it can never be neutral (Vroom, 2006). In addition, it must also be noticed that worldviews can overlap to some extent and evolve, and individuals can adopt certain aspects of multiple worldviews based on certain contexts, philosophical perspectives, and personal beliefs (Ansari, Kant, 2024).

2. Classifications of Worldviews

Worldviews can be classified in various ways, based on the criteria used. However, not all the classifications are directly within the scope of this chapter and two types of classifications are included here that can be discussed in the context of teachers' practices. The first is based on the criteria of being individual or organized, and the second is based on the criteria of including singular or plural ways of knowing.

Firstly, let’s recall that the worldview is a symbolic representation system that allows us to meaningfully integrate our knowledge of both life and ourselves into a holistic structure (Aerts et al., 1994), and look at its classification of individual and organized (Var der Kooij, 2013). Personal worldviews are defined as a set of rules, values, ideals, and practices shaped by an individual's experiences in the sociocultural environment in which they live, while organized worldviews refer to nationally or internationally accepted beliefs, values and philosophies such as humanism, capitalism, and secularism (Aerts et al., 1994). The personal worldview that enables an individual to make sense of their life and the world is like a living organism, evolving in response to their experiences, challenges, and contradictions. Sometimes it can be shaped solely by science or a religious system, and sometimes it can have an eclectic structure that includes some components of organized worldviews. For example, it may contain elements from both secularism and humanism, as well as from a particular religion, sometimes contradictory yet coexisting in a creative tension (Flanagan, 2021). So, it can be asserted that

our way of thinking, our beliefs, our opinions, in other words, our personal worldviews, are generally based on organized religious or secular, that is, broader and systematic worldviews that create pluralistic social structures and guide both individuals and societies (Peterson, 2001). Therefore, it is difficult to fully define and reveal individual worldviews, but individuals' actions and discourses can be considered as important signs of their worldviews. The conflict between theist and atheist biologists, who, despite agreeing on most biological phenomena (including those related to chemistry, geology, and other disciplines), cannot agree on how to interpret these phenomena, generally stems from the differences in their adopted worldviews and this conflict can be considered as an example in this sense. (Gauch, 2009a). Similarly, various preferences and actions of teachers in learning environments can also be considered as important indicators of their worldviews (Ansari, Kant, 2024).

Secondly, worldviews can be classified as singular, pluralistic or eclectic, and within this classification, certain ways of knowing are emphasized. For example, an individual may view only science as a valid way of knowing (scientism) and believe that meaningful answers to their questions can only be found through science, or they may view only religion as a valid way of knowing. Alternatively, religion, science, philosophy, and art may be considered valid ways of knowing within their own contexts and considered as plural or eclectic components that shape worldviews within specific domains. Whether singular or pluralistic, it can be said that the most prominent ways of knowing that shape the discussions in certain fields are religion and science, and therefore religious and scientific worldviews constitute an important agenda. In this section, the religious worldview and its effects on learning environments will be discussed in general terms, and the scientific worldview will be discussed in detail in the next section.

The religious worldview encompasses a rich ontological perspective that includes entities such as God, angels, and spirits, and where natural processes can be manipulated by meditation, prayer, or supernatural forces. This perspective is outside the formal, deterministic nature perspective of modern science (Matthews, 2009). Whether this is a true enrichment or a potential threat to the perspective of the universe presented to students in classrooms requires thorough consideration. Essentially, this debate concerns how different forms of knowledge and their interrelationships should be viewed. Hence, it requires an analysis of forms of knowledge, the processes and methods of knowledge production, and the inclusion of philosophical considerations in learning environments (Matthews, 2009). For example, Guessoum (2010), reviewing Islamic epistemology to reveal the potential for greater harmony between religion and science, argued that science describes nature and natural processes, while

religion offers an interpretive perspective that facilitates understanding the discoveries of science and the cosmos, along with an understanding of existence. In this assessment, he noted that while science and religion may appear to be in competition or conflict as two distinct worldviews attempting to describe reality and existence, this conflict only becomes real when their scopes and modes of action are intertwined.

3. Does Modern Science Require a Particular Worldview?

It can be asserted that individuals' worldview preferences are shaped in the light of empirical and public evidence from different branches of science (science and humanities) and individual experiences that are meaningful to them (Gauch, 2009a). However, it should also be discussed whether science, as a way of knowing, imposes a certain worldview or whether one must adopt a certain worldview in order to do science (Gauch, 2009b). Before entering into such a discussion, both the ontological and epistemological foundations of modern science must be reviewed and for an initial inquiry, the AAAS (1989) report and its sections on the nature of modern science can be consulted.

This report, based on the fact that modern science is a form of knowledge oriented towards the physical realm, first presents an ontological assumption regarding the physical world and emphasizes realism. Following the acceptance of realism, assumptions such as being orderly and knowable are brought to the forefront, and it is stated that the process of knowing requires factual evidence and observational data. This need for factual evidence and data draws a line for modern science, demonstrating that scientific answers cannot be produced for all questions in life. It is argued that, in matters that may be the subject of science, factual evidence and observational data must be considered in accordance with the principles of logical reasoning, and that, in this way, science has become a universal endeavor for all cultural circles and societies.

In this sense, it can be argued that to conduct science, at least in scientific processes, certain ontological, epistemological, and methodological assumptions, and therefore a specific worldview, must be taken as a basis. These assumptions may conflict with an individual's worldview and in such a case, an individual must make either absolute or contextual assessments. In other words, in order to produce knowledge through science or to value the knowledge produced by this way of knowing, they must either contextually adopt the basic assumptions of science stated above or reject them absolutely and remove science from being a valid way of knowing. For example, to conduct science, one must at least embrace

methodological naturalism, that is, to explain phenomena, events, and processes that have occurred, are occurring, and will occur in the universe solely through natural mechanisms and entities, and to exclude all supernatural beings and explanations (Matthews, 2009). The natural mechanisms and entities in question must either have been revealed through science or, in principle, be researchable through science. This methodological naturalism of modern science does not exclude miracles, supernatural interventions, or other unscientific cause-and-effect hypotheses, nor does it require any judgments regarding them, thus it does not constitute an ontological limitation. However, it does state that scientific explanations cannot be produced for claims of supernatural existence and processes.

On the other hand, the ontological version of naturalism takes a much more rigid and dogmatic approach, stipulating that events and processes in the universe can only be explained through science as a way of knowing, and that supernatural or unscientific explanations must be excluded (Matthews, 2009). So, an individual with a worldview based on non-scientific forms of knowledge (religion, philosophy, art, etc.) or an eclectic and contextual framework of these will not be able to embrace and value science that based on the assumptions of ontological naturalism. Because, ontological naturalism goes beyond the methodological version and requires the denial of supernatural and spiritual entities and processes. In such a case, for example, individuals with a religiously focused worldview may contextually adopt methodological naturalism and turn to scientific processes, and this may prevent them from contradicting their own identities or being excluded from science as a way of knowing.

Another dimension of this debate involves the question of whether modern science is a Eurocentric endeavor, essentially a product of Western culture (Aikenhead, Ogawa, 2007). For example, the question of whether it is possible to conduct modern science by approaching the physical world from an animistic perspective can be raised in this context. The answer to this question can be debated in various ways, such as whether analyses conducted with an animistic understanding of nature can still have a place within modern science as a way of knowing. However, the scope of any answers should, in any case, be shaped first by ontological, then by epistemological and methodological foundations. In other words, some of the fundamental principles of modern science outlined above, and the aspects that distinguish modern science from, for example, religion and art, should be considered within a holistic process that progresses from realism to comprehensibility, factual evidence, and logical reasoning. In this way, while it is impossible to definitively answer the question of whether modern science

requires a specific worldview, it can be more accurately evaluated as a way of knowing within the concept of worldview.

Naturalism and its variants, which hold a significant place in the debate over whether modern science offers a distinct worldview, also raise debates about the scope of science, as mentioned above. For example, can science offer answers to such grand questions as whether there is a supernatural creator or whether the universe exists with a purpose? This question naturally pits religion, focused on generating meaning, against science, focused on generating explanation. In this encounter, the scientistic perspective and the acceptance that religion and science are completely distinct ways of knowing constitute the two extremes (Gauch, 2009a). So, considering all its dimensions, it can be argued that there is no simple answer to the debate that forms the subject of this section, and that the answers that can be produced will themselves be shaped by the worldviews adopted. Therefore, while there is no single, absolute answer, it is possible to argue that there are ontological, epistemological, and methodological principles that must be adopted in practice for science to be conducted, and in this sense, methodological naturalism is a prerequisite.

4. Worldviews in the Agenda of Education

Considering the role and meaning of worldviews for individuals, it can be easily understood that how they can be brought to the agenda in education creates a natural context for discussion. Lemettien et al. (2021), arguing that this debate is multifaceted and complex, addressed the issue in four dimensions. In the first dimension, they pointed out that the concept of worldview in education has multiple perspectives, which can address organized systems such as religions and ideologies, or individual perspectives such as attributing meaning and purpose to life (van der Kooij et al., 2013; Lemettien et al. (2021). Organized worldviews can be defined as systems that have been shaped over a long period of time, have traditions, values, rituals and dogmatic elements, and have been adopted by individuals who have made all of these an important part of their perspective on life (van der Kooij et al., 2013).

Personal worldviews, whether religious or secular, which may be associated with an organized worldview, are structures that are reflected in an individual's thoughts and actions but are much more difficult and complex to reveal or explain (Lemettien et al., 2021). Whether personal or organized, worldviews shape the relationships individuals or groups establish with their environments, the answers they generate to existential questions, and their moral values and

principles (van der Kooij et al., 2013), and in this sense, they are one of the determinative elements of life.

In the second dimension, Lemettien et al. (2021) have raised debates about the extent to which religions and worldviews should be included in formal education. Discussions about religious education are closely linked to social and political considerations of religion's place in the secular public sphere and center on the question of whether worldviews should be treated as a public or private matter (Miedema, 2014). Lemettien et al. (2021) argued that, anticipating the continued secularization of modern societies, the place of religion, beliefs, and personal worldviews in education has long been considered a private matter, often being left out even in discussions of intercultural education. However, following conflicts and attacks around the world, discussions about the need to raise awareness of different worldviews and religions have gained momentum (CoRE, 2018).

Lemettien et al. (2021) highlighted debates surrounding the design of the content of curricula in the third dimension. The researcher noted that worldviews also raise questions about the nature, purposes, and organization of teaching about religions and worldviews in public schools. For example, they argued that decisions need to be made about whether information about different religions and worldviews should be presented only in specific subjects or interwoven across a range of subjects, or whether religious education should have a scope that impacts all school activities. In this context, they also referred to discussions (Miedema, 2012) that religious education could be easily integrated into the curriculum through themes such as social sustainability and global citizenship.

Lemettien et al. (2021) addressed the teacher training process in the fourth dimension, stating that if worldview education were addressed as a matter affecting all school life, teacher training would become a priority. In this context, they argued that teachers who understand and embrace differences in society, are pedagogically inquisitive, and capable of reflective thinking should be trained. Such teachers will also facilitate individuals' personal development and identity formation by incorporating cultural materials, living traditions, and practices into educational environments (Biesta, 2020).

4.1. Worldviews and Learning Environments

It has been previously stated that worldviews enable us to make sense of our lives (Naugle, 2002), provide beliefs, values, and principles that shape our ways of thinking and acting, and that awareness of all these makes it easier for individuals to understand themselves

and others (Valk, 2009). Therefore, it has been revealed that worldviews are mental maps that enable individuals to find their way in the social fabric surrounding them and to answer the question of who they actually are (Lappé, Lappé, 2003). Also it has been stated that in order to understand the individual's perspective on life and the universe that constitute the content in learning environments, religious and secular worldviews (CoRE, 2018), which were briefly discussed before under the heading of classification, must also be taken into consideration.

In this section, the place and role of worldviews in learning environments are discussed, briefly touching on learning, teaching processes, and the individual and social roles of education. The primary role of the education system can be said to be to foster an open society capable of critical thinking and questioning. In this sense, the learning and teaching processes should focus on fostering a revision of the knowledge, beliefs, values, and philosophies that constitute worldviews. Education will only be enriched when the big questions are brought to discussion and when individuals both reflect on their own worldviews and explicitly express them, while also examining the worldviews of others. To achieve this, individuals in learning environments must be able to engage in dialogue with religious and secular figures and engage in experiences that will enable them to connect with traditions that give purpose and meaning to their lives (Valk, 2009). They must confront ontological and epistemological questions about their own and others' beliefs and values, and they must understand that worldview neutrality is not entirely possible and that everyone embraces some form of belief and value system (Astin, 2004).

Programs and pedagogy implemented in learning environments should support the development of students' skills in thinking, learning, and using language as a tool for these, and should enable them to reflect in the context of all these processes (McCarty, 1993). In order for these skills and reflections to be developed effectively, students should be positioned not as passive recipients but as individuals who produce knowledge and contribute to the production process, and the teaching process should be planned in a way that will enable them to be open to using their knowledge and sharing their out-of-school learning outcomes (Moll et al., 1992). However, it should be kept in mind that individuals with different worldviews may come together in learning environments, which can lead to communication problems and even conflicts. It should be noted that the primary cause of potential conflicts in such environments is not differences in values, but rather the incomparability of worldviews (Flanagan, 2021).

This discussion is important because disagreements may not be limited to the topics that comprise the content of the social sciences, and even in assessments of physical entities, there may be some possible underlying differences. A realist, an idealist, and a radical constructivist

may all have the same answers to a question about molecules, fossils, or galaxies, but their underlying meanings may differ (Gauch, 2009a). For example, for a realist, the atom is a factual reality, while for an instrumentalist, it may be merely a theoretical entity that facilitates problem-solving and explanation of phenomena. Therefore, it should be known that interpretations of facts and entities are shaped in the light of worldviews and philosophies, and in this sense, worldviews constitute a very important background in learning environments.

So, it can be said that worldviews offer a perspective that positively affects students' introverted and extroverted relationships, social skills, moral development and reflective evaluations of their own values, and enables them to develop critical thinking and questioning skills and socialize in a healthy way in learning environments (Ansari, Kant, 2024). In this context, it is clear that worldview is one of the main elements shaping the network of relationships and functioning in learning environments. However, to understand one's perception of life, beliefs, values, actions, and the culture in which all of these are shaped, one must develop awareness of both oneself, one's own worldview, and other worldviews, whether religious or secular (Valk, 2009). To achieve this, worldviews must be addressed in a qualified manner in learning environments, and big, meaningful questions must be raised. A quality awareness of worldviews cannot be fostered in learning environments where these big questions, encompassing broad social, moral, and theological debates, are not addressed.

4.2. Worldviews and Teaching Practices

Evaluations about the place and role of worldviews in learning environments also require reviewing the effects of teachers' worldviews, which are decisive in the functioning of these environments, on their teaching practices and the identity development of their students. Worldviews are important elements that shape the professional perceptions of teachers, who must possess a range of professional competencies such as pedagogical knowledge, pedagogical content knowledge, and content knowledge (Shulman, 1986), and they provide a personal and interpretive perspective with a set of mental or cognitive representations that include their professional self-image, self-esteem, motivations, and perceptions of the future (Kelchtermans, 2009). This perspective determines the extent to which teachers can contribute to their students' identity development processes while shaping their teaching practices.

It has been stated previously that the ontological dimension of the worldview includes beliefs about reality and existence, and the epistemological dimension includes beliefs about the nature, production and acquisition process of knowledge (Schraw, 2013), and that ontological and

epistemological assumptions must form a meaningful whole for a consistent worldview. The epistemological components within the aforementioned set of assumptions, although not limited to them, are significant determinants of teaching approaches and practices (Kang, Wallace, 2005) and, together with some cultural beliefs and values, affect both students' and teachers' perspectives on science and learning, thus differentiating the way they present/perceive scientific content and processes (Dzama, Osborne, 1999). For this impact to occur in a desired, meaningful, and positive way, the worldviews teachers reflect in the classroom must be compatible with the ontological and epistemological assumptions of modern science, in line with the content of the learning environment. In this regard, the concept of methodological naturalism can be referred to again.

Teachers' worldviews shape their professional development, influencing the decisions they make in their teaching processes, their classroom management approaches, their interpretation of learning environments, and their understanding of measurement and evaluation (Jones, Carter, 2007; Prestridge, 2017). For example, if a teacher holds a worldview based on a progressive philosophy, it can be predicted that they will avoid being an absolute authority figure in the classroom and adopt a more facilitative role (Ansari, Kant, 2024). Such an influence can have repercussions at both formal and informal levels, and teachers may make their own assessments of importance and priorities in the selection and design of the content they present to their students, leading to different preferences (Flanagan, 2021).

On the other hand, the reflection of teachers' worldviews on their teaching practices creates a wide area of influence that cannot be limited to the factors that can only affect the academic development of students and, as stated above, also shapes the identity development of their students. For this shaping effect to be positive, teachers must possess an awareness of other worldviews alongside their own and be able to reflect this richness in their learning environments. Only in such an environment can they bring to their students' attention the big questions about the universe, values, and the meaning of life, as well as existential and metaphysical discussions appropriate to their level. However, in these discussions, the differences that students bring to their learning environments should be taken into account, it should be realized that their identities affect the way they experience these environments, and provisions should be made for these different identities (Nieto, Bode, 2012).

Teachers should be aware that the relationships they establish with their students in learning environments will directly impact their identity development and, in this context, they should seek answers to the following questions (Rogers, 1987):

- Can I enter into and understand students' inner worlds without adopting a judgmental attitude?
- Can I establish a natural, mutually beneficial, open relationship with students where everyone can learn and express themselves?
- Can I explore students' interests and help each one develop in their own areas?
- Can I help students maintain their curiosity about themselves and their environment, and connect with people, books, experiences, and rich resources that nurture their interests?
- Can I approach students' seemingly unusual, immature, or wild thoughts or expressions with understanding and nurture their creative ideas?
- Can I help students develop a holistic identity where their feelings permeate their ideas, and their ideas permeate their feelings?

In order for teachers to give positive answers to these questions, they need to allow their students to reveal their identities and display their experiences, knowledge and skills in their daily learning processes (de Jong, 2011), make them feel that their linguistic and cultural experiences and therefore their identities are accepted, and thus make them more willing to make their voices heard in learning environments (Cummins, 2001). Because students develop identities based on their interactions with others and experiences in their daily lives and learning environments (de Jong, 2011), and these identities shape their later relationships with the outside world, the development of these relationships over time and space, and their projections for the future (Norton, 2013). To positively contribute to their students' orientations, self-esteem, and academic success, teachers must make them feel accepted and, to this end, must establish relationships with them by accepting their identities as they are (de Jong, 2011).

4.3. How to Train Future Teachers for Worldview Issues

Discussions surrounding the significance and decisive role of worldviews in the teaching and learning processes for both students and teachers have clearly demonstrated the need for learning environments to be designed with a culturally sensitive approach. This argument requires taking into account the relevant cultural knowledge, experiences and perspectives of students with different worldviews and cultural origins (Gay, 2010) and strengthening their motivation, interest in the content and self-confidence even if their academic achievements cannot be significantly improved in the first place (Aronson, Laughter, 2016). To achieve this, teachers must be equipped with certain competencies and have developed an awareness of worldviews. However, a look at teacher training programs reveals a lack of

worldview-focused planning or explicitly worldview-focused lessons and practices (at least in the context Türkiye).

In fact, before moving on to the teacher training process, it is necessary to examine the general flow of discussions on worldviews in education settings. These discussions have developed largely under the leadership of scholars working in the field of religious education (Lemettien et al., 2021) and have focused primarily on whether religious elements can be incorporated into formal curriculum (Ubani et al., 2020). However, some policies and outcomes that emerged later have demonstrated that formal learning environments, and particularly teacher training processes, should also include education on religions, worldviews, and values, and that the issue cannot be limited to religious education alone (Ubani, Ojala 2018). Therefore, it is accepted that formal education should provide individuals with the sufficient knowledge and skills necessary to recognize and understand religions and worldviews (Freathy, John 2019). However, the relevant literature raises concerns about the adequacy of teachers' knowledge and skills regarding religions and worldviews (Sakaranaho 2018).

How to overcome the limitations of teacher education programs and teachers' worldview awereness is a significant topic of discussion, and the discussion should begin with the question of whether programs should include courses or course groups that directly and explicitly focus on worldviews, or whether practices should be developed across different subject areas throughout the program. Considering the arguments presented under the subheadings of this book chapter, it becomes clear that the answer lies in developing an attitude and understanding that permeates the entire program. Teacher candidates should be exposed to challenging questions in diverse contexts throughout the program, having the opportunity to reflect on their own worldviews and examine other worldviews (Valk, 2009). Given the diverse content elements across a wide range of disciplines, from science to social sciences, how this opportunity can be implemented in all teacher education programs should be considered by educators in the relevant fields. However, it is clear that some planning can be made, at least within the scope of field education courses that pedagogically prepare candidates for the profession.

For example, in teacher training programs focused on instructional technologies, the transformation of societies and worldviews in the digital age can be discussed. It can be argued that the rapid development of information and communication technologies has tremendously accelerated access to information and led to a significant transformation by providing opportunities for individual communication across geographical boundaries, enabling the

transition of industrial societies to the digital age (Tsybulsky, Levin, 2019). It can further be argued that the digital revolution has transformed how individuals position themselves in the universe, transforming them from passive parts of nature to active beings creating their own artificial worlds, and leading to radical shifts in their consciousness and worldview (Floridi, 2014). In this context, whether the integration of new technologies into learning environments and the transition to technology-focused teacher training programs will occur naturally and how teachers and students can be supported to develop their awareness of this new state of consciousness and worldview (Tsybulsky, Levin, 2019) can be opened to discussion. This brief example can be expanded to other subject areas and contexts.

The following points can be taken into consideration when planning to develop teacher candidates' worldviews in appropriate contexts and throughout their undergraduate education, with support through direct courses if necessary:

- Although the concept of worldview comes to the fore in discussions in the context of religious education (Kimanen et al., 2019), it should be considered as an umbrella concept that includes the teaching of values, ethics and convictions from both religious and secular perspectives (Ansari, Kant, 2024; van der Kooij et al., 2013).
- In worldview education, the increasing incidence of intolerance, both societal and global, must be addressed, and the importance of understanding different cultures, religions, beliefs, and values must be emphasized. To this end, the foundations of this education should be formed by critical thinking, empathy, analytical thinking skills, and tolerance for differences (Ansari, Kant, 2024), and candidate teachers should be able to present and discuss alternative worldviews (Tsbulsky, Levin, 2019).
- Candidate teachers should understand that worldviews, whether in organized or personal form, are one of the important elements of experiences in learning environments and that students come to learning environments with certain identities (Kimanen et al., 2019).
- Candidate teachers should interact with cultural elements that give purpose and meaning to life (Valk, 2009) and confront their own and others' beliefs and values through ontological and epistemological questions (Astin, 2004).
- Candidate teachers should be encouraged to confront a series of philosophical questions that can enrich their own learning and teaching processes (Flanagan, 2021), to deepen their own worldviews while also becoming aware of other perspectives, thus enriching their learning environments (Valk, 2009).

- Candidate teachers should be shown through examples that as they develop their awareness of their worldviews, they will be able to see the effects of these worldviews on their teaching practices more clearly and understand the worldviews of other individuals more easily (Flanagan, 2021).
- Candidate teachers should be made to understand that they are responsible for developing their students' awareness and positive attitudes (acceptance and respect) towards both their, and others' worldviews (Ansari, Kant, 2024).
- Candidate teachers should be made to comprehend that they need to be prepared for multicultural classroom environments, for example, that they may need to communicate in different ways with students from different cultural roots (Kelly et al., 2010), and that if they cannot understand such differences, they may experience serious problems with their students (Flanagan, 2021).
- Candidate teachers should be made to understand that they need to support the cognitive, physical, social, affective, moral, spiritual and aesthetic development of their students in order to ensure that they respect social, cultural and religious differences and embrace global values (Ansari, Kant, 2024).
- Candidate teachers should be trained to understand that they need to develop their worldview awareness to know and understand both themselves and others, as well as their critical thinking and reasoning skills, civic awareness, participation in civil society, and open-mindedness (Valk, 2009).
- For candidate teachers to engage in respectful critiques of beliefs and perspectives, worldviews should be studied directly and explicitly at an academic level, and a foundation should be provided for analyzing primary and secondary sources, reviewing symbolic narratives, and comprehending technical terminology (CoRE, 2018). To this end, a course focused directly on worldviews could be planned in all teacher training programs.

5. Conclusion and Recommendations

It can be argued that the meaning worldviews hold for individuals and the role they play in their lives directly impact perceptions and behaviors in learning environments. In this sense, it can be argued that teachers should be aware of the worldviews their students bring to their learning environments and design learning processes with this awareness in mind. Teachers should not only focus on teaching, but also aim to develop students' thinking and questioning skills, their sensitivity to differences, and their understanding of the dynamics of social life, and

to do this, they should be able to bring big questions into learning environments. These big questions should not be addressed solely within the religious context, but should also be able to raise the meaning and values of life within the context of other worldviews, whether individual or organized. For this to happen, teachers must have a deep understanding of both their own worldview and other worldviews. Therefore, teachers should be prepared for a worldview-sensitive teaching practice from their undergraduate education onward. During this preparation process, they should be presented with worldviews directly and explicitly, they should be provided with opportunities to engage in discussions within exemplary contexts, and they should be encouraged to develop a shared understanding that their students' cognitive, affective, moral, and aesthetic development can only be effectively fostered through such a holistic perspective.

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CHAPTER 2

The Need for Learning in the 21st Century

Özkan AKMAN

Fatmanur ŞAHAN

Chapter Highlights

- The dynamic and changing world of the 21st century was introduced, emphasizing the importance of new learning skills in this context.
- The inadequacies of traditional learning methods and the effects of the modern world (globalization, digitalization, knowledge economy) on individuals and societies were discussed.
- The importance of critical thinking and problem-solving skills was emphasized; the definition, importance, processes, role in individuals' lives, and methods for instilling these skills in children were discussed.
- Communication and collaboration skills were discussed, including the processes of expressing one's thoughts, participating in teamwork, using technology effectively, and respecting different points of view.
- Digital literacy and media awareness were discussed, covering individuals' abilities to effectively use digital tools, critically evaluate information, and correctly understand and use media messages.
- The importance of creativity and innovation, their processes, and methods for developing them in education were discussed, along with learning through experience via design-oriented thinking and the Maker Movement.
- Self-confidence, self-awareness, self-directed learning, and lifelong learning were discussed in terms of individuals' knowledge, skills, motivation, and technology use processes.
- The importance of 21st-century skills, individuals' success in education, social and professional life, and the role of innovation and technology in education were emphasized.

Introduction

Why do we need new learning skills in the dynamic and ever-changing world of the 21st century?

The 21st century is considered the beginning of the digital age, a period marked by an extraordinary acceleration of technological developments and a corresponding remarkable increase in information density (Beers, 2011). In today's world, where technology is changing rapidly, individuals must be open to continuous learning to adapt to this transformation (Medel-Añonuevo, Ohsako, & Mauch, 2001). Furthermore, the globalization of communication, increased transportation opportunities, and the transformation of human life into a multicultural structure highlight the necessity of these skills for achieving success in education and working life (Suto, 2013). In the future, possessing knowledge specific to a particular field will not be sufficient; interdisciplinary knowledge will also be required. The ability to think like experts in different fields will require a basic knowledge of these disciplines; additionally, design-oriented thinking skills will play an important role in solving practical problems (OECD, 2018). Thus, being able to produce innovative solutions to multidimensional problems will become a priority.

Ananiadou and Claro (2009) state that skills enabling individuals to become both active citizens and competent members of the workforce, in line with the requirements of the information society, are considered among the core competencies of the 21st century. 21st-century skills focus less on the amount of knowledge individuals possess and more on their ability to apply that knowledge effectively and functionally (Silva, 2009).

To concretize this understanding of skills, the competency framework developed by P21 outlines the competencies and characteristics that students will need in both their professional and daily lives (Voogt and Roblin, 2012). Within this competency framework: Learning and innovation competencies refer to an individual's ability to adapt to working life and develop their learning processes and innovative thinking skills in increasingly complex living conditions. Information, media, and technology skills encompass the competencies individuals need in areas such as information literacy and media literacy to keep pace with rapidly changing technological developments. Life and career skills refer to certain attitudes and behaviors necessary to achieve success in both professional and daily life (Partnership for 21st Century Skills, 2015). All these characteristics indicate that 21st-century individuals are expected to be critical and creative thinkers, effective communicators, capable of analysis and synthesis,

productive, efficient, possessing leadership qualities, having a developed sense of responsibility, and being entrepreneurial and socially strong (Kurudayıoğlu and Soysal, 2019).

2. The Inadequacies of Traditional Learning Methods and Modern Needs

Traditional teaching approaches are based on a teacher-centered model in which the teacher is the primary source of information. This method commonly uses lecture-style teaching, direct instruction techniques, and rote learning (Sergeeva et al., 2020). It has a teacher-centered, fixed-content structure that progresses at a uniform pace. In this method, knowledge transfer and memorization are at the forefront. Students typically acquire knowledge by listening to lessons and taking notes, with the entire class progressing at the same pace and with the same content. Memorization and mastery of the subject matter are fundamental elements of this method, and assessment is typically conducted through exams (Chen, 2025). However, traditional teaching methods often fall short in ensuring students' active participation in the learning process. Passively acquiring knowledge can lead to disengagement among students and hinder the development of critical thinking skills (Pliushch and Sorokun, 2022). Furthermore, the application of traditional teaching methods presents certain drawbacks, such as material shortages and time and space constraints. Technology integrated into teaching programs plays an important role in overcoming these problems. While the use of information and communication technology tools aims to enrich and improve students' learning processes, it also aims to ensure that these tools are used effectively and efficiently by educators (Değirmenci, 2014). Globalization and digitization have led to significant developments in education. Thanks to these developments, students can access information resources on a global scale, while teachers can plan the teaching process more effectively using digital tools.

3. The Effects of Globalization, Digitalization, and the Knowledge Economy on Individuals and Societies

The convergence between countries in economic, social, and technological fields has increased mutual cooperation and revealed the necessity of acting collectively in a rapidly changing world. Globalization has brought with it the need for nations to adapt to global trends and act together (Dağlı, 2007). Throughout history, globalization has influenced world cultures through various political, religious, and social institutions and contributed to their formation (Merriman and Nicoletti, 2008). Globalization can be defined, in its broadest sense, as the expansion of international relations in the political, economic, and cultural spheres, as well as the process by which both physical elements and abstract values transcend national borders.

This process is not limited to politics and economics; social spheres such as culture, law, education, and entertainment are also among the main areas affected by globalization. Increased interaction and exchange between economies and nations has led to significant changes in these areas (Acar, 2004). Economic structures transformed by globalization have also changed the ways in which knowledge is produced, shared, and used; this transformation has paved the way for a new knowledge-based economic understanding.

The knowledge economy is an economic model that expresses the economic dimension of globalization; in this model, all activities in the current economic system are carried out in a knowledge-focused manner, and knowledge has become an integral part of these activities (Berberoğlu, 2010). Furthermore, the knowledge economy reveals a structure in which innovation and creativity are decisive on a global scale. In a globalizing world, this model, which represents a new economic understanding built on the foundations of knowledge, encompasses various elements (Kevük, 2006).

Indeed, the three fundamental factors shaping the knowledge economy are described as rapid technological developments, the liberalization of trade and financial markets, and the increasing dependence on knowledge in value-added production (Kargı, 2006). In this context, digitization emerges as a critical element that accelerates the fundamental dynamics of the knowledge economy and enables the integration of information into all processes from production to consumption. Digitalization is seen as part of the new techno-culture within the landscape of technological, cultural, and social change (Lister, 2009). With the incorporation of digital technologies into the social structure, the concepts emerging in this field have been embraced by individuals in society, resulting in the development of various social, cultural, and societal definitions. Each new digital concept becomes a tool that transforms daily life and enables individuals to approach the existing order from a different perspective. The process of digitalization, spreading from the individual to society, can be considered an element that shapes the outward appearance of societies. Consequently, a country's level of social development today is largely associated with its capacity for technological adaptation (Özçelik Baloğlu, 2023). This transformation has greatly affected not only the social structure but also education.

Digitalization is a fundamental factor in this process, bringing about significant and profound changes in both the content and structure of education. In general terms, digitalization is defined as the process of adopting a technology that enables people to restructure their traditional

lifestyles and existing work processes through digital technologies, thereby creating new income sources and opportunities for value creation (Yankın, 2019).

4. Critical Thinking and Problem Solving

Critical thinking can be defined as approaching new problems and situations by applying high-level thinking skills; this process involves using a rational and systematic way of thinking to effectively analyze the problem and identify the most appropriate solutions (Beers, 2011). It is a mental competency that emerges when an individual recognizes their own thought structure, consciously manages this structure, and directs the thinking process in accordance with intellectual standards (Cottrell, 2005). At this point, the development of critical thinking skills is directly related to the individual's ability to recognize their thinking habits and manage them consciously.

Critical thinking is an evaluation-based, intellectually questioning process aimed at a specific goal. It involves the effective use of cognitive processes such as interpretation, inference, explanation, evaluation, monitoring, correction, and reasoning. One of the fundamental goals of education is to cultivate individuals who are thoughtful, inquisitive, capable of developing multifaceted perspectives, respectful of others, tolerant of different opinions, and responsible (Facione, Facione & Giancarlo, 2000). In this context, critical thinking is not only an individual mental competency but also a fundamental skill that must be imparted to society through education. Individuals with critical thinking skills should be able to use different reasoning methods (e.g., induction, deduction) as appropriate to the situation, analyze the interactions between the parts of complex systems to reach general conclusions, evaluate alternative perspectives, interpret information and draw conclusions based on the analysis, and evaluate learning processes with a critical approach (Partnership for 21st Century Learning, 2015).

5. Problem-Solving Ability: Breaking Down Complex Problems into Simple Components

Throughout their lives, people encounter many problems, and the process of solving these problems gives meaning to their lives (Üstün & Bozkurt, 2003). People face various situations throughout their lives where they do not know how to react or respond. Such situations involving uncertainty are generally considered problems. Any difficulty that one wishes to resolve falls within the scope of a problem. A problem is an issue with an unknown or complex solution, and the process of solving it requires both research and evaluation. Although individuals are often unprepared for the solution-finding process, they approach it willingly (Van De Walle, 1994). The problem-solving process begins when the individual

realizes that they need to respond at a certain level. Problem solving is a process that involves various efforts to overcome obstacles encountered to achieve a specific goal (Bingham, 1998). In general terms, problem solving refers to a conscious and systematic research process aimed at achieving a clearly defined but not immediately accessible goal related to a scientific subject (Altun, 1995). In real life, personal problem solving is the totality of cognitive, affective, and behavioral processes that an individual carries out to adapt to internal or environmental demands (Heppner and Krauskopf, 1987). Problem solving is the process of determining the correct action to take when it is not clear what needs to be done in response to an encountered problem (Göğebakan, 2012). Problem solving can be defined as the set of mental steps required to achieve a goal or eliminate a problem (Haladyna, 1997). Whether the problems encountered are simple or complex, individuals with problem-solving skills can overcome all types of problems (Güzel, 2004). Students with this skill are expected to be able to solve unfamiliar and differently structured problems using both classical and creative methods, express different perspectives, and ask and define meaningful questions to develop more effective solutions (Yalçın, 2018). Problem-solving skills aim to enable students to develop their ability to make assumptions and, at the same time, increase their capacity for independent and multifaceted thinking (Gömleksiz, Sinan, & Döner, 2019). For example, the problem-solving process in a child can involve a trial-and-error approach until a successful solution is found. Observing others and imitating their problem-solving methods plays an important role in children acquiring these skills. Therefore, problem-solving skills also involve learning through observation. Children demonstrate what they have learned, especially during play. Children can also solve problems they encounter in daily life by role-playing (Atış, Akyol, & Aşkar, 2022).

6. Creativity and Innovation

Creativity means bringing different elements together to form a new whole or arranging existing elements in a different way to produce an original structure. This process involves planning and production that utilize unusual and unconventional situations (Brookhart, 2010). Individuals with creative thinking skills are expected to have a flexible perspective, be open to new ideas, generate original thoughts, develop innovative solutions, and combine thoughts and ideas in unique ways (Wilcox, Liu, Thall, & Howley, 2017). Children can express their creative feelings and thoughts through various activities such as painting, writing, drawing, sculpting, drama, dance, movement, and scientific discovery. Creativity is directly related to how a child approaches a task or a new problem. At the same time, creativity also encompasses the process of learning to innovate (P21, 2019a). To develop creative thinking, it is necessary to use a wide

variety of idea generation methods (e.g., brainstorming), to create new and meaningful information by considering unusual and radical ideas, and to allow individuals to analyze and develop their own ideas. In this process, it is important for education administrators to be open to different perspectives, to understand how new ideas can be integrated into real life, and not to limit creativity and originality. For the innovations presented to be implemented, the information or products produced must be used in practice in a bold, concrete, and useful way (Partnership for 21st Century Skills, 2016).

Innovation, on the other hand, can be defined as the process of generating new ideas more broadly, rather than being driven by specific problems or knowledge gaps. In other words, it encompasses the development of any product or service to be more aesthetic, more functional, and responsive to the needs of more people (EBA, 2016). Children try to understand the world and interact with it by testing their own ideas, experimenting, and learning by doing and experiencing. They often try to adapt to the situations they encounter by imitating the behaviors they see around them. However, when the behaviors they observe and the conventional methods they apply prove ineffective, they resort to innovation by developing new ideas or solutions (Atış Akyol and Aşkar, 2022). The inclusion of creativity in the education system facilitates the development of original thinking by supporting children's experiential learning processes. This strengthens students' ability to produce new and effective solutions.

Design thinking is an innovative and systematic problem-solving approach that aims to develop human-centered solutions and includes elements such as rapid prototyping, learning from early failures, and continuous improvement through iterative processes (Elsbach and Stigliani, 2018). Design thinking is a learning approach that aims to increase students' creative self-confidence. This approach incorporates various components such as establishing empathy, fostering a tendency to take action, guiding thought processes, developing metacognitive awareness, active participation, problem-solving skills, and the use of imagination. Design thinking contributes to diversifying teachers' pedagogical skills and methods, enabling an increase in productivity-focused activities. This process begins with the identification of a problem; it involves conducting research and prioritizing objectives that often appear to be conflicting. As the process continues, different solution paths are tested through prototypes, and in the final stage, the developed products or ideas are evaluated within a social context (Davis, 1998). Design thinking is considered a promising approach in the literature because it has the potential to develop students' creativity and contribute to their understanding of innovation development processes (Martin, 2009).

In the teaching process, teachers take on the primary role of designers because they plan and manage students' learning experiences in the classroom (Kirschner, 2015). In this context, it is the teachers' responsibility to select appropriate tools for students and develop new materials when necessary. At the same time, teachers should set learning goals in a purposeful manner and support students in redefining problems and generating solutions in creative ways. Design thinking means creating effective learning environments for teachers (Kali, McKenney, & Sagy, 2015). The Maker Movement has been shaped by the development of a culture of making, designing, creating, and innovating. This movement supports individuals learning by doing and experiencing, aligning with the constructivist approach to education and harmonizing with modern learning approaches. The Maker approach is a collective formation that brings together collaborative learning, social learning, project-based learning, and individual activities (Schrock, 2014). The Maker Movement is a rapidly spreading trend worldwide that combines technology with a "do-it-yourself" mindset. This movement encompasses many examples of production, such as cooking, model airplane building, and devices prepared with electronic circuits and motors. In addition, products printed with 3D printers, jewelry, decorative items, and toys are also works that reflect the maker spirit (Makers Türkiye, 2015). The Maker Movement was formed by bringing together the cultures of production, design, participation, and innovation. At the core of the movement lies the idea of "do it yourself" or "do it together." This approach manifests itself in many fields, such as textile art, robotics, cooking, carpentry, electronics, digital production, and mechanical repair. In summary, the Maker Movement is an approach that encourages production in all areas (Peppler and Bender, 2013).

Educational makerspaces are designed in line with the concept of learning by doing and experiencing, which forms the basis of the constructivist learning approach. In maker education, students take responsibility for the learning process; they plan and manage their own learning and conduct the necessary research. In this process, the teacher takes on the role of organizing the learning environment, planning activities, preparing the necessary tools and materials, and guiding students (Kurti et al., 2014). Such educational makerspace environments are considered the most suitable learning spaces for maker education. Students actively participate in the process, strive to acquire knowledge, and work collaboratively with their peers. The teacher provides opportunities for students to develop projects and acquire knowledge. Through hands-on activities, students can develop their own designs while also developing their critical thinking skills (Öztürk, 2016).

9. Communication and Collaboration

The 21st century expects individuals not only to possess knowledge but also to use it effectively, work collaboratively, and integrate technology into their thinking.

Communication skills encompass the ability to express thoughts using written, verbal, and nonverbal communication channels; demonstrate effective listening skills to understand meaning conveyed through information, values, attitudes, and goals; and use communication for various purposes such as informing, guiding, and motivating. Furthermore, this skill includes the ability to use multiple media and technologies and to communicate effectively in different contexts (P21, 2019b). This skill is a fundamental element that supports individuals in taking an active role in their social lives and group work. The effective communication dimension encompasses individuals' ability to work in teams, participate in collaborative learning processes, establish healthy relationships with others, behave effectively as individuals, and use technology effectively and responsibly in these processes. High productivity focuses on individuals' ability to plan and complete a project, use technology effectively in the problem-solving process, and produce original, informative, intellectual, or materially valuable products (NCREL, 2003). At this point, addressing communication and collaboration skills together is highly valuable in terms of both individuals' personal achievements and their contributions within the team.

Collaboration is a process in which individuals come together to exchange ideas and try to find solutions to common problems. In this process, the parties try to understand each other's needs, interests, and difficulties; they tend to demonstrate skills such as making sacrifices, showing flexibility, ensuring voluntary participation, and taking responsibility to achieve a common goal (Özgenç, 2012). Young children initially observe the people around them, then begin to share and play. Over time, they begin to recognize the feelings and thoughts of other children. When participating in collaborative activities, they learn to show respect for others, reach compromises, and value different perspectives and skills. Acquiring such social skills at an early age contributes significantly to the development of healthy and positive interpersonal relationships. It is crucial for teachers to transform all areas inside and outside the classroom into appropriate learning environments to develop 21st-century skills. Guiding children to think, research, and ask questions; ensuring they take advantage of all opportunities and technology in the process of accessing information; and encouraging them to collaborate are fundamental elements of this process. Teachers can contribute to students' acquisition of these skills by making small changes to their daily lesson plans. In particular, the use of discovery

learning strategies in small and large group activities facilitates the development of 21st-century skills (Atış Akyol and Aşkar, 2022).

Researchers define online collaborative learning as an interaction that supports social meaning-making and knowledge production among students (Palloff and Pratt, 2010). Students' collaboration toward common goals can be planned and guided in different ways according to the intended learning outcomes. Methods used to implement collaborative learning include collaborative learning activities, group projects, case studies, peer assessments, discussions, and debates. All of these methods can be incorporated into the design and implementation of online courses. Although the concepts of collaborative learning and cooperative learning are often used interchangeably, there are distinct differences between them. Collaborative learning has more specific and structured application techniques (Panitz, 1999).

When students collaborate toward common goals, taking into account different perspectives and cultural diversity creates an effective learning environment. Respecting diversity in collaborative learning processes contributes to the development of students' global communication skills. This enables them to establish healthy and productive interactions in both local and global contexts. Respect for differences is the ability of an individual to recognize the various aspects of events and phenomena occurring in their environment from childhood onwards and to develop a way of thinking about these differences. In this sense, it can be said that this skill is one of the basic social skills that individuals should acquire at an early age (Divrengi and Aktan, 2010). As one of the actions undertaken by societies in their democratization process, the ability to show respect for differences is an important indicator. In this regard, the culture of coexistence can only gain meaning through the recognition of differences. Furthermore, the concept of “difference” should not be understood as the absence of similarities between individuals or beliefs, but rather as a reflection of the diversity created by these elements (Baştürk and Yiğit, 2019).

10. Digital Literacy and Media Awareness

Digital literacy is less a replacement for traditional forms of literacy and more a complementary element that contributes to the general literacy individuals need in areas such as work, learning, and social interaction in today's conditions (Churchill, Oakley, & Churchill, 2008). Furthermore, digital literacy is the awareness, attitude, and ability of individuals to recognize, access, manage, evaluate, analyze, and synthesize digital tools and resources; to generate new knowledge, produce expressions for mass media, and communicate with others

(Martin, 2005). On the other hand, advances in digital technologies have transformed individuals' reading and writing habits; this change has led to digital literacy skills becoming one of the essential competencies required for everyone (Karabacak & Sezgin, 2019). Furthermore, individuals must be careful when using the information they obtain via the internet or when interacting with people they communicate with through social media. At this point, it is crucial to acquire digital literacy skills such as safe and conscious internet use, questioning the accuracy of the information obtained, and being able to find solutions to digital problems encountered. Otherwise, the information accessed may be inaccurate, unreliable, and unverified. Such situations can lead to various negative consequences for both individuals and society (Hamutoğlu, Güngören, Uyanık, & Erdoğan, 2017). In conclusion, digital literacy is a multifaceted form of literacy that occupies a central position in today's digitalizing world and requires individuals to possess various skills, competencies, and levels of understanding (Yay, 2019).

Media literacy encompasses individuals' ability to critically analyze media content; to recognize the tools, intentions, and methods used to create this content; and to evaluate how these messages can influence individuals' thoughts, behaviors, and value judgments. It also involves understanding how personal differences can shape the way these messages are perceived (Partnership for 21st Century Skills, 2008). In short, media literacy can be defined as the ability to perceive messages conveyed by the media, interpret them, and, when necessary, recreate them (Hobbs, 1998). Media literacy involves correctly perceiving and critically evaluating media messages; distinguishing between reality and fiction; understanding that the world presented by the media may not always reflect reality; and recognizing the media's functions of influencing and controlling. It also ensures awareness that those conveying the message may be attempting to impose their own views. In short, media literacy aims to cultivate individuals who can accurately evaluate and appropriately utilize information, regardless of the source (RTÜK, 2016). 21st-century media skills are based on individuals' ability to access, understand, and analyze media messages.

11. Self-Confidence and Self-Directed Learning

Self-confidence encompasses an individual's evaluations of themselves; their beliefs about how valuable, successful, important, and adequate they perceive themselves to be, and their attitudes toward accepting or rejecting themselves (Coopersmith, 1967). Self-confidence is often linked to an individual's actual performance (Franks and Marolla, 1976). The perception of self-confidence as a critical factor in success necessitates the identification of the

characteristics of individuals with low and high self-confidence. Individuals with high self-confidence tend to view the problems they encounter as opportunities (Jain, 2010). These individuals are generally described as responsible, open to new experiences, enterprising, successful in social relationships, and possessing a positive outlook. At the same time, they perceive themselves as valuable and important individuals. Individuals with low self-confidence tend to compare themselves to others and, by placing excessive importance on what those around them think, often evaluate themselves as inadequate (Altıntaş, 2015). This situation can make them more susceptible to psychological problems such as depression and anxiety (Baumeister, Campbell, Krueger, & Vohs, 2003). An individual's perceptions and beliefs change not only their level of self-confidence but also their self-awareness. Self-awareness also has an important place in this context.

Self-awareness is defined as an individual's ability to realistically assess their emotions, motivations, and desires, and to be conscious of their own strengths and weaknesses (Kernis, 2003). It also means recognizing one's immediate emotions, having a critical perspective on one's abilities, and developing a balanced sense of self-confidence (Elias and Moceri, 2012). Self-awareness is a process that involves an individual reflecting on themselves; through this, the person becomes aware of their own characteristics, can maintain this awareness, and can use it effectively in social relationships or behaviors. This process involves mental activities that include introspection, self-evaluation, and deep thinking (Chon and Sitkin, 2021).

12. Lifelong Learning

Lifelong learning encompasses the learning that individuals acquire throughout their lives in every environment they encounter, including school, home, workplace, and all areas of life (Güleç, Çelik, & Demirhan, 2012). This type of learning is independent of limitations such as age, educational level, or social status. For this reason, lifelong learning should be considered a process that supports the professional and social development of individuals and society and ensures the continuous acquisition of knowledge and skills (Strengthening the Vocational Education and Training System Project, 2006). The most important features that distinguish lifelong learning from other education-related concepts are that it has a person-centered approach, values learning processes outside of school, transforms the traditional function of school, reduces the dominant role of the state in education and increases the influence of social stakeholders, and does not limit education to a specific time frame. This approach encourages investment in knowledge and people while also contributing to individuals acquiring the basic skills necessary to sustain their lives (Güleç, Çelik, & Demirhan, 2012).

Motivation is a process that drives an individual to act toward a specific goal and sustains that behavior (National Research, 2018). In general, motivation can be defined as a dynamic state of arousal that initiates, directs, regulates, strengthens, terminates, and evaluates cognitive and motor processes, along with identifying, prioritizing, and converting desires and wishes into action (Dörnyei & Ushioda, 2011). It encompasses the individual's selection, initiation, and maintenance of goal-directed behavior. Motivation can be approached in different ways depending on the individual's personal characteristics, the conditions they are in, or the context of the activity they are involved in (Svinicki and Vogler, 2012). Generally, individuals tend to learn topics that they are curious about and that attract their attention more quickly and easily (Selçuk, 2001). In this context, it can be seen that the factors shaping student motivation have a multidimensional structure. Student motivation can be linked to many different factors, ranging from individual characteristics and abilities to the quality of learning materials used, the learning environment, motivational elements, and teacher attitudes (Slavin, 2013). The most effective way to increase student motivation is to improve teaching quality, create a rich and balanced curriculum, and implement a supportive, informative assessment system (Robinson, 2017). Learning tools and technology-supported solutions play an important role in supporting student motivation by improving teaching quality.

The effectiveness of the changes and developments targeted in education depends primarily on correctly identifying the areas that need to be updated. Considering the two fundamental elements of education—teachers and students—it is inevitable that the proposed innovations should be shaped around these two actors. Like all areas that adapt to a changing world, teaching and learning tools must now be restructured according to the needs of the age; this is no longer a choice but a necessity (Aras and Kocasaraç, 2022). Today, advances in science and technology are leading to fundamental changes in the structure of society and forcing the education system, which must adapt to this change, to transform. Modern technology and innovations are a continuation of the changes that past technological developments have brought about in education and are shaping the society of the future. Advances in information technology directly impact both educational methods and content (Alkan, 2005). In the field of education, numerous digital and technological tools such as the internet, computers, smartphones, e-book readers, z-books, and tablets are utilized. Initially, the use of technology was considered solely to support the teaching of specific subjects, but over time this understanding changed, and technology began to be used with the goal of educating individuals in line with the needs of the era (Kaya, 2019). Later, projects such as the Movement for

Increasing Opportunities in Education and Improving Technology (FATİH) and the Education Information Network (EBA) were developed to spread technology-supported educational applications (Kolburan Geçer and Bakar Çörez, 2020).

13. Conclusion

Advances in technology, innovations in science, the effects of globalization, changing expectations in the labor force, economic pressures, and the rapidly changing concept of competition in today's society have made it necessary to redefine the skills required for individuals to contribute to society and adapt to different areas of life (Levy and Murnane, 2005). These competencies, referred to as "21st-century skills," encompass the skills individuals require in many areas, such as education, working life, and social life, in line with the needs of the era (Griffin, McGaw, and Care, 2012). Individuals possessing 21st-century skills can be more successful both in their educational and professional lives (Ball, Joyce, and Anderson-Butcher, 2016). They contribute to individuals leading a quality life, solving problems they encounter more easily, approaching events in their environment from different perspectives to produce solutions, and being successful in both their professional and social lives (Anagün, Atalay, Kılıç, & Yaşar, 2016).

The assimilation and adoption of 21st-century skills by society is of vital importance for social development and social welfare. Increasing the number of individuals who possess skills such as critical thinking, digital literacy, problem solving, creativity, collaboration, and effective communication is of great importance in the formation of an active, productive, and highly conscious society. These acquired skills enable innovative solutions to social problems while also encouraging active participation. They contribute greatly not only to individuals' own success but also to achieving the goals of social cohesion, sustainable development, and equality.

In today's rapidly changing world, adapting to change and remaining in a continuous learning process is more important than ever. In this context, simply possessing knowledge is not enough; the ability to adapt to changing conditions and sustain personal development has also become extremely valuable. Innovation in education aims to equip individuals with these skills, preparing them for a volatile and competitive business world. Qualities such as creativity, flexibility, and resilience play a decisive role in students' personal development through the contribution of innovation in education (Altan, 2023). Innovation is a process that combines creativity and entrepreneurship. Innovation and entrepreneurship are directly linked not only to

creativity and productivity but also to the level of knowledge and learning capacity. This process of establishing connections is shaped by the knowledge base, learning skills, and creative thinking abilities that educational institutions impart to students.

Individuals educated in this manner are expected to be confident, unafraid to ask questions, enjoy research, and be able to generate solutions to the problems they encounter. On the other hand, it is quite difficult for individuals who think based on rote learning and accept things without questioning to achieve success in innovation processes (Kınıkoğlu, 2004). Teachers' understanding of the types of intelligence, areas of interest, and difficulties faced by their students contributes to the development of effective solutions tailored to their needs. Approaches that address different areas of intelligence and offer a variety of learning experiences are the cornerstones of innovation in education. The integration of technology into education makes the learning process more interactive and enjoyable, allowing students to progress at their own pace. Online education platforms support this process by offering rich and varied content that supports different learning styles. Therefore, it is extremely important for teachers to use technology efficiently and for the education system to remain up-to-date with the requirements of the age (Eser, 2023).

Future learning environments are evolving into more flexible structures that are student-centered rather than teacher-centered and enhanced with digital capabilities. In these environments, students are developing into individuals who not only consume information but also produce it, investigate its accuracy, question it, and manage their own learning process. Innovative platforms such as virtual reality, augmented reality, artificial intelligence-supported applications, and personalized learning environments will significantly contribute to making learning more interactive and support students' active learning. As a result, innovation in education will be of great importance in enabling individuals to be successful, productive, and adaptable in the digital age.

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CHAPTER 3

Sustainable Development and Education

Pelin KÖSEOĞLU

Chapter Highlights

- Sustainable development and the 2030 UN Sustainable Development Goals were explained, and the implications of the 2030 UN Sustainable Development Goals for education were discussed.
- The concept of sustainable development and education as a transdisciplinary process was discussed. Eco-Schools and Green Campuses-UI GreenMetric World University Rankings applications were explained as reflections of the fundamental goals of sustainable development and education.
- The relationship between sustainable development and education, environmental education, and climate change education was explained.
- The place and importance of all these topics in teacher training processes was emphasized.

Introduction

We do not inherit the earth from our ancestors; we borrow it from our children.

A Native American Proverb

Data from the Turkish State Meteorological Service (MGM) shows that 2025 will be the driest year for Türkiye in 65 years. Decreased rainfall due to the climate crisis has caused water levels in dams to drop both in Turkey and globally. Recent news shows that we are facing ecological crises as well as social and economic problems during the summer months. For example, drinking water resources in İzmir, one of Türkiye's largest provinces, have become insufficient. With only 10 days of drinking water remaining, the city has faced regular water outages to maintain its resources (İZSU, 2025). Water shortages and drought are just some of the major problems faced today due to environmental problems. These problems cause not only ecological but also economic and social impacts. Sustainable development is a concept that was introduced to maintain the balance between these three major components and to protect the

planet's present and future from these problems (Harrison, 2000). The success of sustainable development requires transformation not only in global policies but also in education systems and individual awareness. This book chapter aims to explain sustainable development in the context of the environment, economy, and society, and introduce the United Nations 2030 Sustainable Development Goals. This chapter will approach sustainable development and education as interdisciplinary processes, emphasizing the importance of environmental education and raising environmental awareness. It will also discuss how these processes can be integrated into education, including climate change education, and will delve into sustainable development-related practices in critical areas such as teacher education. Within this framework, this book chapter covers the following topics: Sustainable Development, the 2030 United Nations Sustainable Development Goals, Quality Education (Goal 4) and the Education for Sustainable Development and Global Citizenship Sub-Goal, Climate Action (Goal 13), Sustainable Development and Education as an Interdisciplinary Process in Teacher Education, Eco-Schools & Green Campuses-UI GreenMetric World University Rankings, Environmental Education in the Context of Sustainable Development, and Climate Change Education in the Context of Sustainable Development.

1. Sustainable Development

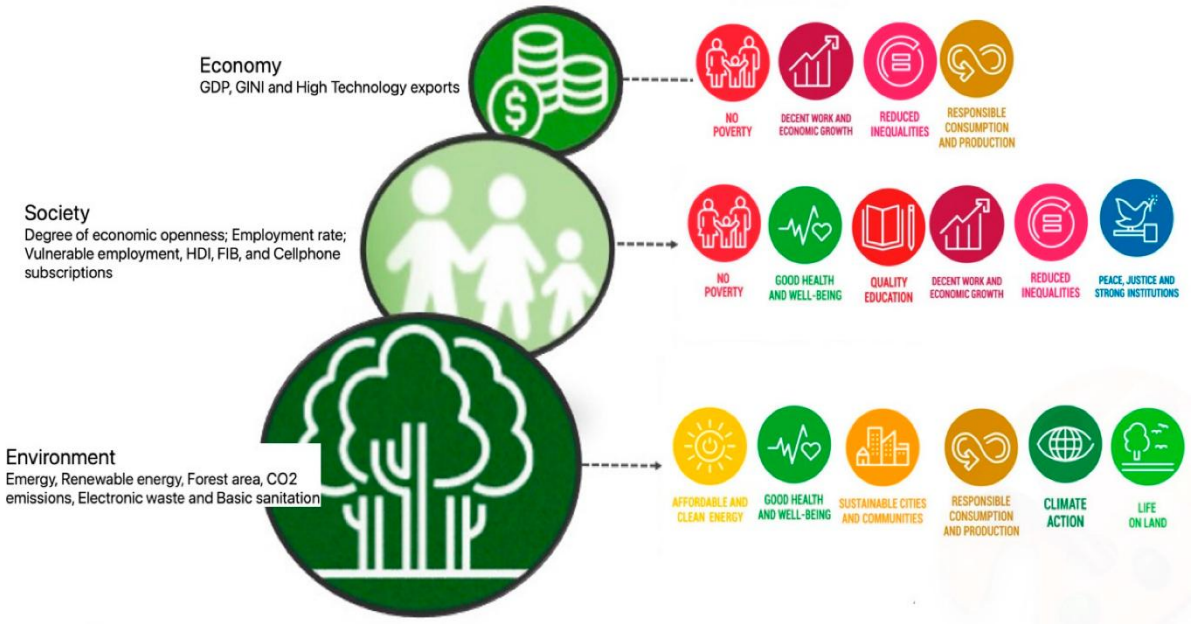
The global temperature has risen by 1.2 degrees Celsius since the Industrial Revolution. This increase in global temperature has, unavoidably, caused forest fires, floods, tornadoes, and storms. All these disasters have destroyed the natural habitats of living things. Today, 25% of the world's species face extinction as deforestation continues unabated in the Amazon. These events cause not only ecological but also social and economic problems because environmental problems mostly affect poor and fragile societies, and some regions in the world are described as being more susceptible. For example, the Mediterranean basin in Türkiye is now known as a climate sensitive hotspot (IPBES, 2019; IPCC, 2023). "Climate migrants" is a concept that has emerged due to people who have been forced to migrate due to severe climatic conditions outside the seasonal norms, and this concept is now included in the reports of the United Nations (Picchi, 2016). In short, environmental issues are no longer simply a matter of ecology. It has come to affect the economy, society, and many social structures. This is what environmental problems are now described as a global crisis. Solving it is a process that concerns the whole world and requires cooperation. Sustainable development is an important concept that come to the fore at this point. In the Brundtland Report published in 1987, sustainability was defined for the first time as the balanced maintenance of the relationship between people and the

environment with all its environmental, economic, and social dimensions. The concept of sustainability places emphasis on balanced development and the conservation of existing resources. Whereas development is the process of improving indicators such as equal opportunity in health, education, and income while national income and the economy continue to grow. In short, development is the increase in the living standards of a society based on social justice while the economy is growing (Todaro & Smith, 2020).

Sustainable development is based on considering future generations and protecting their ability to meet their needs while meeting mankind's needs today. The goal behind this definition is to create a common global view to protect the future of the planet (World Commission on Environment and Development, 1987). In short, it is to meet today's needs and at the same time ensure the protection of natural resources for future generations. This being so, one can talk about three dimensions of sustainable development: economy, society, and environment. These three pillars of sustainable development are explained below (Figure 1).

Figure 1.

Environmental, Society And Economic Dimensions Of Sustainable Development (https://sdgs.un.org/goals)



The economic dimension of sustainable development argues that economic development should take place by protecting the environment and social justice. Regular growth, profit making and productivity, which are the basis of the economy, come to the fore when considered with a sustainable approach, ensuring the continuity of production-consumption processes while

guaranteeing the protection of natural resources for a long time. Human needs are unlimited, but the natural resources to meet them are limited. Therefore, these limited resources should be used efficiently without being wasted (Harrison, 2000). Some 80% of the energy used in global production is still provided by fossil fuels. Fossil fuels are one of the main reasons for the deterioration of the balance of the environment and the occurrence of environmental problems (IEA, 2000). The economic dimension of sustainability supports the concept of green economy for precisely this reason. The concept of green economy encourages the use of renewable energy sources that cause less or no harm to the environment. The environmental dimension of sustainability is based on the protection of the environment as a whole with all its elements. It emphasizes that natural systems should be protected with energy efficiency and waste management while meeting daily needs. In other words, environmental sustainability should ensure the stable use of natural resources, limit fossil fuel consumption, and increase the use of renewable energy sources. Thus, the balance of the atmosphere, biodiversity, and all elements of the environment that do not appear to be an economic resource should be preserved (Harris, 2020). The social dimension of sustainability includes all the social services a society needs. These are services that ensure social sustainability, such as the right to education, the right to health, and gender equality (Gedik, 2020). The fact that sustainable development consists of the components of society, economy, and ecology is why all governments are the common subject of many disciplines, including the social sciences and science, in terms of both politics and policies (Yeni, 2014). Sustainable development in teacher training has become an important topic that spans all disciplines. In order to examine the place of sustainable development in education in more depth, we need to talk about the history and current goals of sustainable development.

2. 2030 United Nations Sustainable Development Goals

People first became aware of environmental issues in the 1960s. However, its emergence dates back to the Industrial Revolution in 1765. Developments in industry and industrialization with the Industrial Revolution were accompanied by many new technologies. These developments in industry and technology changed the structure of society and triggered the unconscious use of natural resources. Furthermore, led to the use of fossil fuels and the resultant release of greenhouse gases, enough to upset the balance of the atmosphere. Since the 1960s, environmental issues have been one of the most important issues for which solutions are sought in a global context. Environmental education and sustainable development became part of the international agenda in the 1970s and 80s. The Tbilisi Declaration in 1977 provided an

international context for determining the goals of environmental education and outlining its framework. The Brundtland Our Common Future Report in 1987 revealed what strategies should be used with a sustainable development approach to leave future generations with a habitable planet (World Commission on Environment and Development, 1987). Another important development was the Kyoto Protocol in 1997. The Kyoto Protocol was the first major meeting to seek solutions to climate change, one of the most important environmental problems affecting the living conditions of living things (UN Framework Convention on Climate Change, 1998). The parties to this protocol have to observe the targets set to reduce greenhouse gas emissions. The World Summit on Sustainable Development held in 2002 aimed to find solutions to the problems encountered with implementing Agenda 21, in particular, 10 years after the Rio Conference on Environment and Development held in 1992. Where nations stood in terms of sustainable development was also discussed at this summit (UN, 1992).

The Sustainable Development Goals are a prime example of collaboration to find solutions to the world's problems. These goals were adopted by 193 nations. They were set in 2016 with the primary objective of achieving them by the end of 2030. When we look at the period before the 2030 UN Sustainable Development Goals, we find the UN Millennium Development Goals. Covering the years 2000-2015, these goals pursued the same objective. The UN Millennium Development Goals can be listed as Eliminating Extreme Poverty and Hunger (Millennium Development Goal 1), Providing Universal Primary Education (Millennium Development Goal 2), Promoting Gender Equality and Empowering Women (Millennium Development Goal 3), Reducing Child Mortality (Millennium Development Goal 4), Improving Maternal Health (Millennium Development Goal 5), Combating HIV/AIDS, Malaria and Other Diseases (Millennium Development Goal 6), Ensuring Environmental Sustainability (Millennium Development Goal 7), Global Partnership (Millennium Development Goal 8). The 2030 UN Sustainable Development Goals are an improved version of the targets set in the Millennium Development Goals that existed between 1996 and 2015 (Bebbington & Unerman, 2018). The 2030 UN Sustainable Development Goals consist of 17 main and 169 sub-goals (UN, 2015). These targets are shown below (Figure 2).

Figure 2.

2030 UN Sustainable Development Goals (https://sdgs.un.org/goals)

The 2030 UN Sustainable Development Goals include targets on many issues such as poverty, hunger, health, education, gender equality, clean water, clean energy, decent work and economic growth, sustainable cities and societies, climate change, and land and water ecosystems. In order to explain the place of sustainable development in teacher education, we need to focus on two main goals. The first of these is SDG 4 - Quality Education. Another is SDG 13 - Climate Action.

2.1. Quality Education (Goal 4)

Quality Education is one of the 2030 UN Sustainable Development Goals. Its main purpose is to provide inclusive and fair quality education for all and to promote lifelong learning opportunities. Today, the schooling rate in developing countries is over 90%, but it is known that more than 50 million children are still unable to go to school. According to UNESCO's report in 2017, the schooling rate decreased significantly in disadvantaged regions such as the Sahara Region and South Asia between 2000 and 2012. This is why Quality Education is one of the main problems of sustainable development and is based on equal education for all. The most important feature of the Quality Education goal is that it plays a key role in achieving all the 2030 UN Sustainable Development Goals. Only through education is it possible to find solutions to all environmental problems, reduce societal inequalities, and ensure that all people can build a healthy and sustainable life. This is why Quality Education differs from all other SDGs (UN, 2015).

Ten sub-objectives need to be achieved first in order to achieve the Quality Education SDG. These sub-objectives include access to free and quality primary and secondary education for all female and male students. The primary objective here is to achieve pre-school education so that children are ready for primary education before starting primary education, and to gain proficiency in basic reading and mathematics skills at the primary education level. Again, it is expected that by 2030 gender equality will be eliminated and that children with special needs or from migrant/refugee, or socio-economic or socio-culturally fragile backgrounds will have equal access to all levels of education. Similarly, the goal here is to ensure that all people, regardless of age group, have equal access to all levels of education and vocational training. When the sub-objectives are examined in the context of teacher education, we can see that sustainable development education, in which social and societal issues such as human rights and gender equality are included, is on the agenda. The national education policies, curricula and teacher education processes of the countries that have adopted these goals should be considered in this context. One of the sub-goals of Quality Education is education for sustainable development and global citizenship. This sub-goal is explained as "By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and culture's contribution to sustainable development" (UN, 2015).

2.2. Climate Action (Goal 13)

Climate change is the only environmental issue included in the 2030 UN Sustainable Development Goals. Climate Action, which is the 14th SDG, plays a leading role in the search for a global solution to climate change. It includes urgent measures to combat climate change and its impacts, including strengthening all countries against natural disasters caused by climate change and incorporating this in national policies. Another measure is to impart all knowledge on this subject through environmental education to find a solution to climate change, raise awareness, and develop institutional capacities accordingly. Climate Action also involves supporting effective planning and management of climate change in underdeveloped countries to cover all disadvantaged groups affected by climate change. Climate Action is a goal that lies at the center of all other sustainable development goals and goes hand in hand with many goals (UN, 2015). The figurre below shows the sub-objectives of Climate Action and the relationship between these sub-objectives and other objectives (Figure 3).

Figure 3.

The Relationship Between Climate Action and Other Goals (https://sdgs.un.org/goals)

The consequences of climate change are also accompanied by many natural disasters. Therefore, solving climate change will end poverty (SDG 1), reduce famine and drought (SDG 2), and protect health (SDG 3) and the ecosystem and biodiversity (SDGs 14 and 15). One of the solutions to climate change is to create sustainable and climate-resilient societies (SDG 11). This requires energy efficiency and the efficient use of natural resources (SDG 12). Fossil fuel use causes excessive greenhouse gas emissions and should be reduced (SDG 7). Each situation mentioned for the solution aims to turn a society that is not environmentally friendly into one that is. In other words, making environmentally unfriendly behavior environmentally friendly is regarded as the basic solution. Education is the process of desired behavioral change. Therefore, Quality Education (goal 4) is crucial for increasing knowledge and capacity on climate change (Table 1). For all these reasons, we have to examine these two vital goals from the perspective of educators and explain the processes of sustainable development and education, environmental education, and climate change education by associating them with teacher training processes. Furthermore, the historical progress of sustainable development is reflected in education as sustainable development and education, environmental education and climate change education.

Table 1.

The Relationship Between Climate Action and Other Goals

SDG	Relation to Climate Action	SDG	Relation to Climate Action
	Disasters caused by climate change mostly affect socioeconomically weak societies.		The use of fossil fuels for energy results in excessive greenhouse gas emissions. This in turn disrupts the balance of the atmosphere. Greenhouse gases are the main cause of climate change. The transition to renewable energy will help reduce greenhouse gases.
	Temperatures outside the seasonal norms, drought, famine, forest fires, floods, and storms all threaten food security.		Climate-resilient cities should be developed; societies should also become climate-resilient.
	The devastating consequences of climate change cause many climate-related diseases.		The efficient use of natural resources is one of the basic solutions suggested for all environmental problems, particularly climate change.
	One of the sub-objectives of Climate Action is to build the knowledge and capacity to combat climate change. Only with education is this possible.		Climate change directly impacts ecosystems and biodiversity. Unavoidable forest fires, increases in sea levels, and changes in the regime of ocean currents, temperature, and salinity all directly affect the terrestrial and aquatic ecosystem.
	One of the most important consequences of climate change is its negative impact on water resources. Climate change negatively impacts both the quality and quantity of water.		

3. Sustainable Development and Education

Sustainable development and education exist to ensure that countries, societies, and the individuals make choices in line with sustainable development goals. It aims to safeguard the present and future of the planet by making the behaviors of individuals sustainable (Türer, 2010). Only through sustainable development and education will people get the prosperous life they deserve. Although every technological development meets the needs of people and increases their living standards, it is not possible to talk about wellbeing in a life where the natural balance disappears. A quality life, which is the right of every human being, can only happen with decisions that serve sustainable development goals. When considered in the context of the individual, every person should be conscious and aware of this subject. With sustainable development and education, individuals are expected to turn what they learn about sustainable development first into values and attitudes, and then into behaviors in their own lives (Wals, 2011).

Sustainable development and education aim to make human behavior environmentally friendly and sustainable because the main cause of environmental problems is unconscious human activities (Erten, 2004). These activities not only disturb the environmental balance, but they also have economic and social consequences. For this reason, the concepts of environment, economy, and society are not only the basis of sustainable development, but they are also directly involved in sustainable development and education (Summers, Kruger, Childs & Mant, 2010). Many social, economic, and ecological issues such as poverty, hunger, clean water, gender equality, the right to equal education, sustainable cities, and living on water and land are the main issues of sustainable development and education. This wide range of subjects includes many disciplines. This is why sustainable development and education is treated as an interdisciplinary approach in addition to changing the knowledge, attitudes, and behaviors of individuals for a sustainable future and thus their whole way of life (United Nations Educational, Scientific and Cultural Education [UNESCO], 2002). Real-world problems cannot be broken down into disciplines. The problems that affect everyone cannot be solved with science, social sciences, and social studies alone. The causes and consequences of all other sustainable development issues, especially environmental issues, are intertwined. All these complex problems form a whole and are, therefore, not easy to solve. For all these reasons, all the problems on which sustainable development is based constitute one of the biggest real-world problems. The main goal is to train students who can find solutions to real-world problems in today's education systems (Republic of Turkey Ministry of National Education,

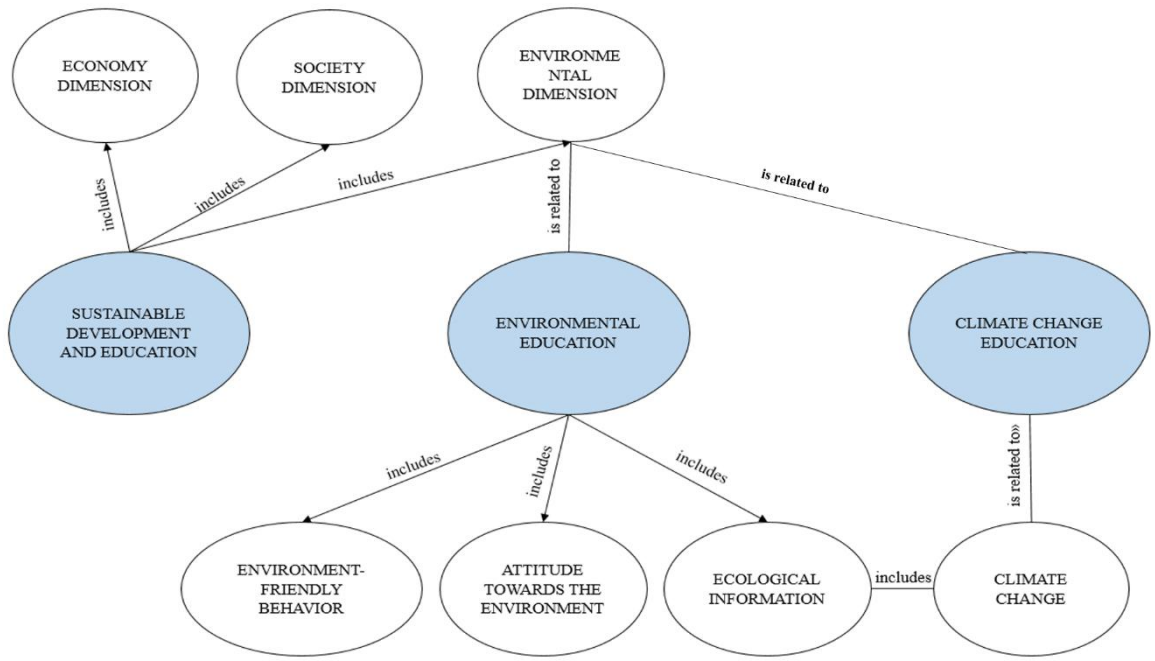
2023). Sustainable development and education also affect the current context of teacher education.

The interdisciplinary dimension of sustainable development and education can be explained more clearly with an example. Clean Water and Sanitation is the sixth of the 2030 UN Sustainable Development Goals. When we consider this fundamental goal in the context of disciplines, then water, water cycle, water pollution, and the protection of the aquatic ecosystem fall under science and biology as an abiotic factor that makes up the environment. Chemical wastes that cause water pollution, water treatment processes, chemical analysis, and water cleanliness also belong to the natural sciences and the chemistry discipline. Meanwhile, the distribution of water resources plus their associated problems and management, and the right to water are all associated with the social sciences and geography discipline. The conscious use of water resources and the importance of protecting water resources in society are sub-topics of life science. The collection and analysis of numerical data on water use is associated with the mathematics discipline. Although the design of wastewater treatment technologies and water-saving systems is related to technology and design, the development of ethical awareness within the framework of responsibility for water, the right to creation, respect for the environment, and preserving resources for future generations may be related to religious culture and moral knowledge. The teachers who will tackle these issues play a key role in the field. Therefore, the teachers and preservice teachers of the future must not only know about this topic but also have knowledge of the methods and techniques that will bring all these disciplines together in addition to having critical thinking skills and being able to collaborate. Sustainability literacy in the Turkish Century Education Model is one of the basic literacy models regardless of branch (Republic of Turkey Ministry of National Education, 2023). Therefore, it is imperative to address this issue in the current context in teacher training undergraduate programs. For example, a report describing the basic steps for a sustainable future in France states that all efforts to find a place for sustainable development in teacher education must be made the sake of a livable planet (Bregeon et al., 2008). However, sustainable development and education includes many concepts. Its abstract and complex structure can create uncertainty about how to incorporate it into teacher education programs. The research conducted by Falkenberg and Babiuk with five education faculties in Canada in 2014 is one such example of this interpretation. The 2012 report of the United Nations Economic Commission for Europe (UNECE) provides a sharp framework for ensuring that teachers and preservice teachers have a sustainable lifestyle and question their own behavior.

Due to the issues on which they are based, sustainable development and education are intertwined with both environmental education and climate change education as a newly emerging approach (Figure 4). The environmental dimension of sustainable development & education and environmental education are directly related to each other. Sustainable development and education is a more expanded form of environmental education with the added dimensions of economy and society. Climate change is one of the basic concepts of environmental knowledge. Furthermore, one of the 2030 UN Sustainable Development Goals is Climate Action. As such, climate change education is a part of both sustainable development and education and environment education (Barak & Gönençgil, 2020).

Figure 4.

Sustainable Development and Education, Environmental Education, Climate Change Education.



The foundations of environmental education are based on the Tbilisi Declaration in 1977, while the foundations of sustainable development and education are based on the 1987 Our Common Future Report and the 1991 Agenda 21 Action Plan. Looking at their respective histories, we see that environmental education was taken up before sustainable development and education. After people realized the other dimensions of environmental problems that affect everyone, the context was expanded and it was understood that a holistic perspective was needed. According to the Tbilisi Declaration, the dimensions of environmental education should be awareness, knowledge, attitude, skills, and participation. Awareness includes gaining sensitivity to the environment and environmental issues; having experiences about knowledge, the environment, and environmental issues; having a set of values related to attitude and relevant issues; skill and all the skills necessary to find solutions to problems. Participation involves taking an active role in existing efforts to solve environmental problems. Agenda 21 called for vocational education that not only meets the needs of both the environment and development but also provides access to educational opportunities regardless of social status, age, gender, race, or religion. Sustainable development and education still bears the traces of Agenda 21 and its context is based on the 2030 UN Sustainable Development Goals. Environmental education, on the other hand, has covered biodiversity and climate change issues ever since the Tbilisi Declaration. The current condition of climate change introduced the concept of climate change education. This is why climate change education is an integral part of environmental education or sustainable development education (Mckeown & Hopkins, 2003)

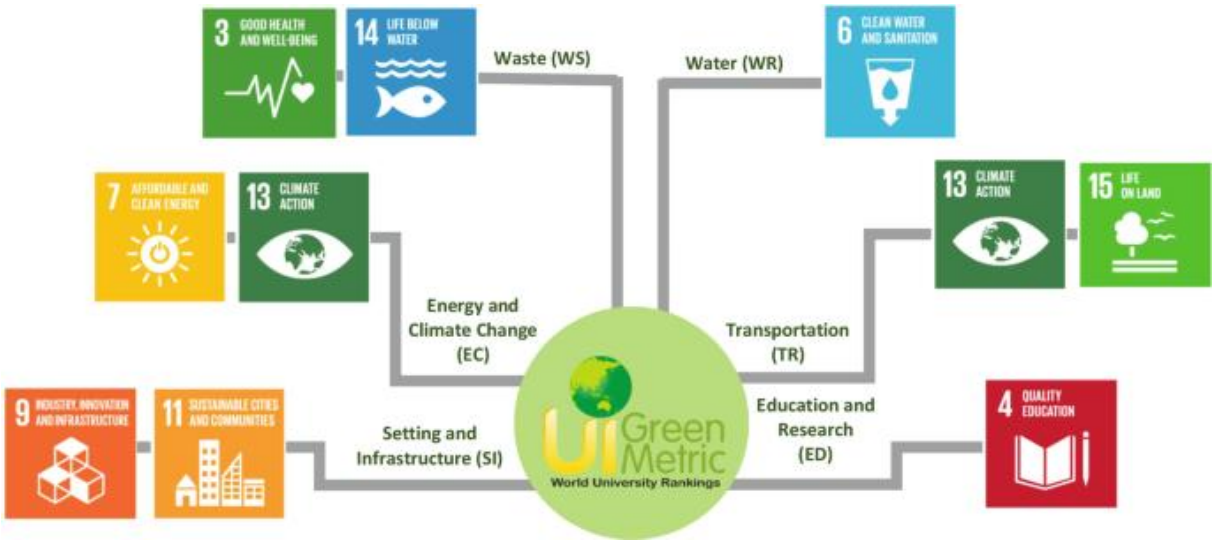
3.1. Eco-Schools & Green Campuses-UI GreenMetric World University Rankings

There are two important examples showing how sustainable development is reflected in schools. These are the UI GreenMetric World University Ranking and Eco-Schools. The main purpose of the UI GreenMetric World University Ranking is to ensure sustainable development in education. It takes the form of a self-assessment tool with which universities all over the world can achieve their green campus objectives and make campuses sustainable. In short, it measures the sustainable development performance of university campuses and ranks universities according to their scores in this area. This reveals the strengths and weaknesses of universities in connection with their approaches to sustainable development. In doing so, it provides a roadmap to build on strengths and improve weaknesses. This ranking brings universities together in an international network on sustainability and supports the sharing of knowledge and experience, while increasing awareness about internationalization, recognition, and sustainability. This brings about social change within the campus. It encourages

environmentally friendly behaviors such as energy saving, waste management, preserving and increasing green areas, and reducing the carbon footprint of each of the university's stakeholders. It also supports developments in increasing environmental knowledge, which is the first step in creating environmentally friendly behavior by evaluating courses, research, and social contribution projects in the context of sustainable development and the environment (Yılmaz & Biçer, 2024).

Figure 5.

UI GreenMetric & 2030 UN Sustainable Development Goals (https://greenmetric.ui.ac.id/)



An example of how sustainable development is reflected in primary and secondary education is eco-schools. One of the projects aiming to create environmental education-based schools is the international Eco-Schools Project. Schools are the main settings for explaining environmental education and environmental ethics to children raised in the age of technology and plastic (Nagra, 2010). Eco-schools are the main settings where environmentally friendly behaviors will be gained to create a sustainable planet. Eco-schools is a model for creating eco-friendly schools as a whole and provide tools and infrastructure to promote sustainability in their communities, including students, teachers, and parents (Eames et al., 2008). It exists in 30 countries and has a total of 7500 schools. The main factor behind students achieving all these gains is undoubtedly teachers who are environmentally conscious. Such teachers should have up-to-date ecology knowledge. They should know about the causes and effects of all environmental issues, particularly climate change, which is one of the most important current environmental problems, and they should know what needs to be done to solve these

environmental issues. They should follow all developments related to not only the ecological dimension but also the economic and social dimension of environmental problems. In addition to environmental knowledge, teachers should gain a positive attitude towards the environment and environmentally friendly behavior (Erten, 2004). In its 2017 report, UNESCO emphasizes that teachers should have sufficient professional development to convey all sustainable development goals to students. An environmentally conscious individual is the key to environmental education. The project ensures that environmental issues in schools are transferred from the curriculum to daily life. It enables students to comprehend the importance of the environment. As part of this project, the "Green Flag Award" is given to schools that have achieved outstanding success with their work and environmental education (Figure 6). The award is an internationally recognized and reputable, environmentally responsible eco-label. Students gain environmental awareness through these schools and adopt lifestyles that are sustainable and nature-friendly (TÜRÇEV, 2019).

Figure 6.

Green Flag Award.

The UI GreenMetric and Eco-Schools are briefly summarized in the table below with their educational level, target audience, main goal, 2030 UN Sustainable Development Goals, success criterion, and relationship with teacher education (Table 2)

Table 2.

Comparison of UI GreenMetric and Eco-Schools

Dimensions	UI GreenMetric	Eco-Schools
Level	Higher Education	Primary and Secondary Education
Target Audience	University administrators Academicians University students (preservice teachers)	School administrators Teachers Students Local environment, including parents
Main Goal	Sustainability in education Campus sustainability Supporting research on sustainable development	Developing students' environmental awareness Instilling environmentally friendly behavior
Contribution to 2030 UN Sustainable Development Goals	Developing environmental awareness in all university stakeholders Ensuring academic production Policy development related to green campus practices	Designing an interdisciplinary environmental education process Developing environmental awareness and lasting environmentally friendly behavior in all school stakeholders
The Measure of Success	International ranking Gaining prestige	Receiving a green flag award Being part of a global structure
Relation to Teacher Education	Preservice teachers who receive teacher training on a sustainable green campus will graduate as environmentally friendly teachers.	Only environmentally friendly teachers will raise environmentally friendly students.

4. Environmental Education in the Context of Sustainable Development

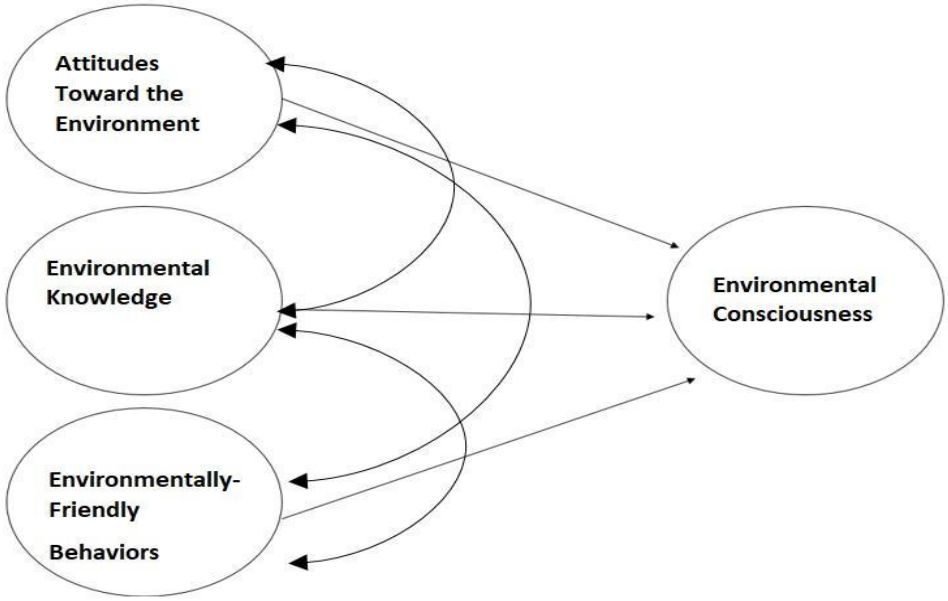
Environmental education is an integral part of sustainable development, but it is limited to the ecological dimension. It is a concept that emerged after environmental problems were identified in the 1960s. (Ünal & Dımışkı, 1998). In the early days, environmental education aimed to inform all societies about protecting the environment, but over time it aimed to provide continuous skills in protecting the environment (Peyton et al., 1995). Improving environmental awareness is only possible through environmental education. Solving environmental problems is only possible with sustainable societies formed by environmentally conscious individuals. As environmental problems affect everyone, especially fragile societies, it is vital for the future of the planet to raise environmental awareness in societies and for every person to adopt environmentally friendly behaviors. This is why environmental education is so much more than the transfer of knowledge (Tilbury, 1995). Environmental education is a complex process that addresses the cognitive, affective, and psychomotor domains. It does not belong to a single discipline; rather, it transcends them all. This is because environmental problems are not a matter of a single person, a single society, or a single region. They are a problem that affects the entire world (Erten, 2004).

Environmental awareness includes environmental knowledge, a positive attitude toward the environment, and environmentally friendly behavior (Figure 7). Environmental knowledge includes all basic ecology knowledge and all current developments related to ecology. The definition of the environment is all knowledge relating to solving environmental issues such as the biyotic and abiyotic elements that make up the environment, the interaction and equilibrium between these elements, matter cycles, environmental problems, energy efficiency, and waste management. In addition to all these, cryptocurrency mining also includes treating new technological developments such as cryptocurrency mining and artificial intelligence as next-generation environmental issues. Students will develop positive feelings toward the environment the more they learn about ecology. The prerequisite for developing a positive attitude towards the environment is knowing more about the environment. Only by doing this can individuals exist who are happy with all environmentally friendly behaviors and who feel sad and responsible when faced with the disasters caused by environmental issues. The attitude dimension encompasses all feelings and thoughts, both good and bad, toward environmental issues. Environmentally friendly behaviors are all behaviors that benefit the environment. When this attitude turns into behavior, environmental awareness will have been instilled. Conscious and sustainable consumption, saving, not wasting, not littering, walking short distances, using

bicycles, using public transportation for long distances, recycling with a zero waste approach, planting trees, and protecting green areas are all environmentally friendly behaviors (Erten, 2004, 2019).

Figure 7.

Environmental Consciousness (Erten, 2004)



In short, creating conscious societies to protect the environment is possible with teachers, who are the mainstay of the education system, to make environmental education effective. Teacher education is key to implementing environmental education in schools, regardless of whether they are preservice or in-service. UNESCO frequently emphasized supporting the professional development of teachers in the context of environmental education at environmental education conferences held in 1975, 1977, and 1987. In addition, UNESCO published many sample materials that dealt with environmental education in teacher education between 1980-1990, and these materials were tried by many researchers (Álvarez-García et al., 2015). Even today, environmental education is still a topic of conversation in a global context. The Education for Sustainable Development Goals: Learning Objectives report published by UNESCO (2017) says that preservice teachers should be supported not only with knowledge, but also from the standpoint of sustainable development values and pedagogical approaches. Environmental education will also serve the 2030 UN Sustainable Development Goals.

In the current context, environmental education should provide teachers or preservice teachers, future teachers, with knowledge about the environment and sustainability. Teachers should

know the causes and effects of climate change and what needs to be done to solve it. Climate change is one of the most basic and current concepts of environmental knowledge, which in turn is one of the basic components of environmental awareness. This is why climate change education exists as a separate topic. Teachers should also be competent enough to transfer their ecology knowledge to their students. They need to be able to design teaching programs in keeping with the transdisciplinary structure of environmental education, and they need to have the necessary knowledge and equipment to create learning environments for students by doing and experiencing. Out-of-school learning environments are an integral part of environmental education. Teachers are required to include non-governmental organizations such as national parks, wildlife parks, botanical gardens, treatment facilities, the WWF, and TEMA [The Turkish Foundation for Combating Soil Erosion, for Reforestation and the Protection of Natural Habitats] in their teaching processes. First and foremost, teachers should be role models as environmentally friendly individuals (Erten, 2004).

5. Climate Change Education in the Context of Sustainable Development

Climate change is considered as a crisis today. The consequences of climate change have affected almost the entire planet. The main consequences of climate change include the following: Deteriorating rainfall regimes due to climate change; irregular rainfall cycles as a result, and onset of drought. It is known that this situation negatively affects agricultural yield, natural vegetation, and water resources (Bolan et al., 2024). Very high temperatures affect human health directly, such as sunstroke, and indirectly, such as the spread of disease carriers, nutritional disorders, and migration (Kim et al., 2014). Climate change increases the risk of species extinction as it disrupts the balance of air, water, land, and forest ecosystems as well as the migration routes of some species. Disasters caused by climate change cause huge economic losses. These losses are felt more in underdeveloped countries and regions with weak infrastructure. The melting of glaciers raises sea levels and causes flooding in coastal areas. Moreover, warming of the oceans directly and adversely affects the aquatic ecosystem (Khojasteh et al., 2023). People must be made environmentally conscious if a solution is to be found to all these adversities. Climate change education has been adopted as the main solution to eliminate the fear and anxiety caused by climate change (Mochizuki & Bryan, 2015). This will make it possible not only to combat climate change but also to adapt to it (Açıkalın et al., 2024). The main purpose of climate change education is to teach how nature works and which human behaviors disrupt the balance of nature. The causes and effects of climate change, the current situation of climate change and the reactions to it, and our responsibilities to prevent

climate change are the subjects of this training (Anderson, 2010). Considering that the main cause of climate change is greenhouse gas emissions, it can be said that climate change education is related to reducing fossil fuel use and preventing deforestation.

Just like sustainable development and education and environmental education, the teaching of climate change involves more than one discipline. For this reason, it is thought that the presence of courses that only include issues related to sustainable development, environment, or climate change may not be enough (Erten et al., 2022). All courses, even curricula, have to be environmentally friendly as a matter of necessity. However, there are also studies suggesting that it would be beneficial to teach climate change as a separate course. In their study in 2025, Karaaslan and Çetin examined the curriculum of the Environmental Education and Climate Change course taught in secondary schools affiliated to the Republic of Türkiye in the context of disciplines. One of the conclusions of this study is that this curriculum covers many disciplines such as chemistry, geography, law, psychology, political science, and politics. The fact that a course on climate change is meshed with so many different disciplines tells us that the teachers of this course should also have sufficient knowledge about these issues. Theoretical information on teacher education processes related to this subject is no different from sustainable development and education and environmental education. However, raising awareness about climate change is one of the main agendas of country administrations today. One of the important examples of this is the Climate Change Action Plan of the Ministry of National Education of the Republic of Türkiye. The Climate Change Action Plan aims to make educational institutions aware of the effects of climate change. The topics that make up the action plan include disasters and measures due to climate change, energy efficiency, water conservation, air, water, soil pollution, zero waste approach, and the effects of climate change on the environment and public health. The purpose of this action plan is to increase Turkish teachers' current knowledge about the environment and climate change. Again, this action plan can be seen in the objectives of including the components of sustainable development, environment, and climate change in university education and ensuring that teaching materials are environmentally friendly in order to support preservice teachers (Ministry of National Education of the Republic of Türkiye, 2022).

6. Sustainable Development in Teacher Training

Environmental problems will be solved through environmentally friendly societies. Creating environmentally friendly societies is only possible with environmentally friendly teachers. Environmental education plays a crucial role in teacher training to achieve this goal.

The objectives of environmental education in teacher education are explained below (Ünal & Dımışkı, 1998):

- To enable teachers to consider the environment as a whole with all its living and non-living elements, to understand not only the complex interaction and balance between all these elements but also the relationship between all this information and sustainable development
- To ensure that teachers take responsibility for nature with an ecocentric approach and in this case, think about both current and future generations
- To support teachers' professional development so that they can design an adequate teaching program for environmental education
- To enable teachers to recognize the interdisciplinary nature of environmental education
- To provide teachers with the pedagogical qualifications necessary to communicate effectively with their students
- To instill in teachers a positive attitude and value judgments regarding the environment in order to protect the environment and find solutions to environmental problems
- To ensure that teachers regularly follow up-to-date information, constantly renew their knowledge and skills, in short learn how to learn

Sustainable development and education represent a broader framework within which environmental education incorporates economic and social dimensions. For these reasons, all the objectives of environmental education in teacher education also apply to sustainable development and education. A review of the relevant literature reveals numerous studies on the role of sustainable development in teacher education. A 2018 study by Anyolo et al. reveals that teachers want to increase their knowledge of sustainable development and education. This research suggests that sustainable development should be incorporated into curricula as a separate interdisciplinary course. In their 2018 study, Bürgener and Barth stated that it is important to train teachers who are motivated, competent, and committed to sustainability in order to transform the structure of society. This research reveals that simply having knowledge of sustainable development is not enough. It is also important to support teachers in integrating sustainable development into their learning environments. Real-world problems should be integrated into learning environments through projects in which students actively participate. Therefore, teachers should also develop their professional knowledge within the context of sustainable development and education. In their 2013 study, Rauch and Steiner argue that teachers and students will learn to consider not only the present but also the future through

sustainable development and education. They argue that being responsible for protecting resources today and tomorrow is only possible through sustainable development and education. It is well known that teachers, through their own lifestyles, serve as role models in this regard.

In summary, it's crucial for teachers to gain knowledge and awareness about sustainable development. Their professional development needs to be supported to integrate this topic into their learning environments. It's essential for them to serve as role models through their own lifestyles and support social learning. Teachers acquire all this knowledge and skills through pre-service and in-service training. Therefore, the content of courses focused on sustainable development and education in undergraduate teacher training programs is crucial. In her 2020 study, Korkmaz examined the 2018 Teacher Training Undergraduate Programs of the Council of Higher Education of the Republic of Türkiye in the context of sustainable development. Related research has revealed that all topics related to sustainable development and education in curricula are included in elective courses. Furthermore, these topics aim to increase knowledge rather than attitudes, behaviours, consciousness, and awareness. It has been observed that the content of these courses emphasizes all dimensions of the concept of sustainability, including society, environment and economy. To achieve its goals in teacher training, sustainable development and education must be enhanced in undergraduate programs. Learning environments that integrate all disciplines and address environmental, economic, and political issues should be created.

7. Conclusion

Sustainable development is an indispensable paradigm for resolving crises affecting every aspect of life. This chapter emphasizes that environmental problems such as climate change, biodiversity decline, and global warming; social issues such as eliminating inequalities in health and education; and economic issues such as drought, unplanned urbanization, and decent work cannot be addressed alone. Furthermore, this chapter explains the importance of considering ecology, economics, and social justice as a whole. The 2030 UN Sustainable Development Goals are a roadmap for fundamental solutions to all these issues. In particular, the Quality Education and Climate Action goals are integral parts of this roadmap, both politically and educationally (UN, 2015). In the context of sustainable development, education is an important force for creating sustainable societies, finding solutions to the most real daily life problems and saving the future (Wals, 2011). In this context, teacher education is crucial for developing teachers' environmental awareness and sustainable behaviors, and for teaching them the necessary professional knowledge to incorporate these into their teaching processes.

Without environmentally conscious teachers, it is impossible for future generations to have the necessary awareness for a sustainable planet (Erten, 2004).

Another point emphasized in this section is the multidimensional nature of sustainable development and education. Sustainable development and education primarily focus on economic, social, and ecological issues. The interdisciplinary nature of sustainable development and education stems from their interconnectedness with real-life problems. Furthermore, examples from Eco-Schools and the UI GreenMetric World University Rankings demonstrate that sustainability does not exist as a standalone subject at different levels of education, but rather represents an approach that transcends all disciplines. These examples not only increase awareness of the issue but also impact the immediate environment, aiming to create environmentally friendly societies (Yılmaz & Biçer, 2024; TÜRÇEV, 2019). Furthermore, the intertwining of sustainable development and education with environmental and climate change education offers a deeper perspective for teacher education.

In summary, all the goals of sustainable development and education are inseparable. Through education, individuals can acquire all the knowledge, values, and skills necessary to solve these problems. Teachers' critical role in transforming societies is key to solving these complex issues. The future of the planet depends on training environmentally friendly teachers. Therefore, the content of courses on sustainable development and education in undergraduate teacher training programs is crucial. Furthermore, it is imperative that educational policies that directly impact curricula, schools, and classrooms become sustainable. Sustainable development is not merely a political, economic, ecological, or global agenda; it is every individual's responsibility to nature. Everyone who cares about the future and its children must do something about this. Thinking about future generations is the basis of teaching.

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CHAPTER 4

Socio-Scientific Issues in Teacher Training

Aysun ÖZTUNA KAPLAN

Chapter Highlights

- Socio-Scientific Issues (SSI) was introduced as a contemporary framework connecting scientific knowledge with ethical, political, and social dimensions.
- The conceptual foundations of SSI and their relationship with evolving understandings of scientific literacy were discussed.
- SSI's educational functions and contributions were reviewed, emphasizing their role in developing critical thinking, argumentation, ethical reasoning, and democratic citizenship.
- Pedagogical models for teaching SSI, including Sadler's SSI Teaching Framework and Friedrichsen's SSI–5E Model, were examined as practical guides for classroom implementation.
- Sample lesson scenarios illustrated how SSI-based instruction enhances student engagement and promotes evidence-based reasoning and social responsibility.
- The chapter concludes that embedding SSI in teacher education is essential for cultivating scientifically literate and socially responsible educators capable of guiding students toward a sustainable future.

Introduction

Whether we realize it or not, humanity is surrounded by the accelerating changes in science and technology and the consequences of these changes. From processed foods on supermarket shelves to genetically modified foods, stem cell research to CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) and gene editing applications, digital surveillance to big data, scientific and technological advances in many areas impact our lives. Each development challenges us to reflect on its scientific content and social, political, and ethical dimensions. These thought-provoking issues are both scientifically addressed and of public interest; they are complex, have no definitive answers, are open-ended, are often controversial, and are called socio-scientific issues (SSI) (Sadler, 2004). The SSI have become the focus of today's discussions and have begun to play a central role in education. Indicators

of the dire need for this evolution in education can be seen in the reports of many institutions. The World Economic Forum's Global Risks Report 2025, the Intergovernmental Panel on Climate Change (IPCC), and the United Nations Environment Programme (UNEP) foresight reports list global priorities and risks, replete with various SSI such as climate change, environmental degradation and biodiversity loss, epidemics, pandemics, technology, and information security.

To take measures to address global priorities and risks shaping our future, it is essential that education be shaped accordingly, and SSI be incorporated into curricula. Due to their controversial nature, the content of the socio-scientific problems will allow students to connect scientific knowledge to real life, thus providing an advantage in fostering multidimensional scientific literacy. Therefore, young people will develop not only into knowledgeable individuals but also into individuals who can question, debate, and make decisions, becoming more competent and effective in addressing the global priorities and risks that await us.

In this context, the role of teachers is indisputable. They should be able to expose their students to different perspectives, encourage them to think, and engage them in pedagogical discussions of sometimes complex ethical dilemmas. However, expecting such guidance to occur automatically is not a rational approach. Teacher training should be structured accordingly, ensuring that they undergo educational processes that will equip them with content and pedagogy to develop a strong understanding of SSI. Therefore, focusing on SSI and approaches to teaching them in teacher education programs has become a preference and a significant necessity.

Based on this need, this section will explore the importance of SSI in teacher education and discuss how prospective teachers can develop scientific literacy, critical thinking, and inquiry skills through these topics. In this way, we offer a perspective on how socio-scientific issues can be considered teaching content and a transformative force in education.

2. Conceptual Foundations of Socio-Scientific Issues

2.1. What is Socio-Scientific Issues (SSI)?

Some questions are difficult to answer! Some answers are difficult to substantiate. For example: "Should the freedom of individuals who refuse vaccination take precedence over public health?, Are carbon taxes and emissions trading fair?, Does using genetically modified products in agriculture reduce hunger while putting ecosystems at risk?, Should geoengineering

projects that reflect sunlight, such as releasing particles into the atmosphere, be implemented to solve the climate crisis, or do they carry the risk of irreversibly damaging nature?" Such questions spark debates at various levels, from individuals to societies. Such issues cannot be resolved solely with scientific knowledge; they are complex structures that must be addressed within the framework of ethical values, social interests, and individual decisions. In the literature, these multidimensional topics are called Socio-scientific Issues (SSI) (Sadler, 2004; Zeidler et al., 2005).

Socio-scientific issues can be defined as topics related to scientific concepts or technological developments that concern society, are often complex and controversial, and involve social, economic, political, and ethical dimensions alongside scientific knowledge. These problems are open-ended with no single correct answer and require the discussion of different perspectives and value judgments for their solution (Ratcliffe & Grace, 2003; Sadler, 2004; Zeidler & Nichols, 2009; Zeidler et al., 2005). Sociobiological topics include nuclear energy, fossil fuels, renewable energy, hydroelectric power plants (Kumar et al., 2024; Levinson, 2006; Ozturk & Bozkurt Altan, 2019; Ratcliffe & Grace, 2003; Sadler, 2004), genetic testing, CRISPR, GMOs (Genetically Modified Organism), cloning, stem cells, vaccines (Dawson & Venville, 2009; Levinson, 2006; Salmon, Omer, 2013; Zeidler et al., 2005), climate change, global warming, environmental pollution, water scarcity, and biodiversity loss (Chang & Chiu, 2008; Tytler, 2012; Ratcliffe & Grace, 2003). With scientific and technological advances, the variety and range of these topics are expanding.

Not every scientific issue will have a social context and may not be controversial or open to debate. Therefore, mentioning specific criteria that make an issue SSI is useful. Since this section deals with SSI in teacher education, selecting SSI is also essential. The prominent characteristics of SSI in the literature can be listed as follows (Kolstø, 2001; Ratcliffe & Grace, 2003; Sadler, 2004; Sadler & Zeidler, 2005; Zeidler, 2014):

- Having a scientific basis, but not being solvable by science alone
- Being controversial and open-ended
- Involving complexity and uncertainty
- Having social significance
- Requiring critical thinking and decision-making
- Having an interdisciplinary structure

To illustrate these characteristics with examples, some view genetic interventions as medical progress, while others consider them an ethical risk. Climate change is at the intersection of scientific data and economic and moral policies. The choice between nuclear energy, fossil fuels, and renewable energy has become a topic of energy policy and involves discussions of multiple possibilities with no definitive solution. Issues such as food safety, health risks, and vaccination are of social importance because they directly affect the lives of individuals and society. Artificial intelligence is a good example of the interdisciplinary nature of socio-scientific issues, involving the interaction of technology, law, ethics, and psychology.

As can be seen, socio-scientific issues surround our lives. Therefore, both as individuals and as part of society, we must not remain indifferent to SSI issues. We must enhance our scientific literacy to view these issues comprehensively, engage in meaningful discussions, and make sound decisions.

2.2 Scientific literacy and SSI

Scientific literacy, one of the fundamental goals of contemporary science education, refers to competencies such as acquiring scientific knowledge, understanding scientific processes, and being able to use this knowledge in social contexts, making personal decisions, and possessing knowledge and understanding of scientific concepts and methods to embark on careers in science and technology (Bybee, 1995; McComas, 2014; Roberts, 2007). Scientific literacy has been a concept discussed in science education for a long time before evolving into its current meaning.

Rooted in Enlightenment thought and progressive educational philosophy, scientific literacy initially became prominent in John Dewey's experience-based and problem-solving approach to education, where it was associated with learning the scientific method and rational citizenship (Dewey, 1930). After World War II, it became a strategic goal for national development and technological advancement (Bush, 1945; DeBoer, 2000). From the 1970s onwards, it expanded with criticisms that scientific literacy could not be reduced to mere knowledge gaps and that science needed to be understood in its social context, along with elements of trust and identity (Wynne, 1992).

In the 2000s, Roberts (2007) defined two visions in the literature: Vision I emphasizes the transfer of scientific knowledge and methods; Vision II emphasizes the social context of science and its relationship to citizenship. This distinction showed that scientific literacy means not only acquiring knowledge but also relating that knowledge to daily life, politics, and ethics. In

recent years, an approach called Vision III has emerged. This approach addresses scientific literacy in the context of environmental issues, social justice, and ethical dilemmas, anticipating that individuals will not only possess scientific knowledge but also become active citizens who seek solutions to social problems with critical awareness (Sjöström & Eilks, 2018; Feinstein, 2011).

With its contemporary interpretation, scientific literacy encompasses not only possessing conceptual knowledge but also the ability to understand the nature of science, evaluate scientific arguments, and analyze the relationships between science, society, and technology from a multidimensional perspective (OECD, 2019). It is integrated with SSI, which involves decision-making processes based on inquiry and social responsibility. The foundations of the SSI approach can be found in contemporary interpretations of scientific literacy. In particular, Roberts' (1982, 2007) distinction between "science for science" (Vision I) and "science for society" (Vision II) emphasizes the need to consider the social and ethical dimensions of science in education. From this perspective, SSI is a practical reflection of Vision II and emerges with Vision III. In this context, individuals who will participate in and decide on discussions about SSI must have a high level of scientific literacy. What knowledge and skills a scientifically literate person should possess is widely debated (Bybee, 1995).

One of the names in this debate, Shamos (1995), states that individuals can be scientifically literate at varying levels, ranging from having enough scientific knowledge to understand scientific problems, even if not to the extent of being able to solve them, to having the level of scientific knowledge required to enter professional science. He examines levels of scientific literacy in three dimensions: 'cultural, functional and true'. The characteristics of scientifically literate individuals in these dimensions are as follows: Culturally scientifically literate individuals know the scientific jargon found in newspapers and similar publications, but their scientific literacy is limited to this. Functionally literate individuals use their knowledge correctly and meaningfully in speaking, writing, and reading, albeit not technically, on top of the framework of cultural literacy. However, at these levels, there is a lack of scientific process, the characteristic feature of science, which is the ability to research and organize information correctly, and the theory's fundamental role in scientific applications. The level at which these deficiencies are addressed is true scientific literacy. True scientific literate individuals know the scientific process and the nature of science. They appreciate the importance of scientific inquiry, questioning, analytical thinking, logical thinking, and relying on impartial evidence.

McComas (2014) states that Bybee, who played a significant role in developing scientific literacy terminology, does not view scientific literacy as an end state but instead defines scientific literacy in two dimensions: 'breadth and depth.' Breadth extends from vocabulary recognition to conceptual understanding and then to contextual understanding. Depth, on the other hand, involves understanding scientific concepts, research, and processes. In terms of the qualities of these dimensions, scientific literacy levels acquired throughout life are divided into five levels (Bybee, 1995):

- *Scientific illiteracy:* A situation that arises due to a person's age and developmental level.
- Nominal literacy: This is a situation where basic concepts are understood, but there are many misconceptions and misunderstandings about science. Individuals at this level recognize science terms but do not fully understand their meanings. The individual's perception is at a minimum level compared to the scientific understanding accepted for their age and developmental stage.
- *Functional literacy:* Science can only be used within a specific context. Depending on their age, developmental level, and education level, individuals can read and write texts containing scientific and technological information and use scientific terminology. However, this use is limited to specific activities and requirements, such as recognizing terms in a text, reading scientific content in a newspaper, or listening to a television program.
- *Conceptual and procedural literacy:* Individuals demonstrate an integrated understanding of science and technology, recognizing their structure and the processes for generating new knowledge. For example, they can identify relationships among key biological concepts such as evolution, energy, genetics, variation, and ecology, and they are proficient in fundamental scientific practices, including observation, hypothesis formulation, and experimental inquiry.
- *Multidimensional literacy:* Individuals grasp the fundamental conceptual structures of science and technology and their interconnections with society. They recognize the nature and role of science, the use of technology in daily life, and the philosophical, historical, and social dimensions that shape these disciplines.

To understand SSI, to be equipped to participate in discussions related to SSI, and to make decisions on issues concerning nature and society, one must be scientifically literate in what Shamos calls 'true' and Bybee calls 'multidimensional' terms. This can only be achieved through

quality education. SSI plays an essential role in this education. Indeed, Sadler (2004) emphasizes the educational importance of SSI, stating that teaching socio-scientific issues enables students to approach scientific knowledge critically and develop the decision-making, argumentation, and reasoning skills central to scientific literacy.

3. Place of SSI in Education

3.1. Educational Function and Importance of SSI

In the previous section, we discussed the intersection between the characteristics sought as indicators of scientific literacy and the behaviors expected from individuals in the societal reflections of SSI. Under this heading, based on the aforementioned organic connection, information will be provided about the function and importance of SSI in science education.

Lindsey (2011) identifies two key drivers of change in science education: global challenges such as climate change, the energy crisis, obesity, biodiversity loss, genetic research, and the continuous flow of related information through the internet and media. These developments necessitate new skills enabling students to engage with scientific issues critically. Consequently, initiatives such as Science-Technology-Society (STS), Science-Technology-Society-Environment (STSE), Science for All, Science for Public Understanding, and Citizen Science have emerged. In this context, the concept of scientific literacy -introduced by Hurd (1958)- has become central to shaping modern science education. Despite its evolving definitions, it remains a core goal of national curricula and a key construct in international assessments such as the OECD's PISA.

Science teaching based on the discovery of socio-scientific issues (SSI) has been presented as a powerful strategy to support the development of students' science learning and scientific literacy (Presley et al., 2013). This is because addressing socio-scientific issues in education develops students' scientific content knowledge and equips them with democratic participation, problem solving, value-based decision making, and social responsibility (Sadler, et al., 2007). In this respect, socio-scientific issues are at the heart of contemporary science education and transform individuals from "information consumers" to "conscious decision-makers." Hodson (2011) emphasizes that SSI plays a central role in integrating science education with perspectives of social justice and a sustainable future.

Given the nature of SSI, it is both a goal and a tool in education. Hodson (2011) points out that while it is an educational goal for our global priorities, it also emerges as a powerful tool for fostering scientific literacy. Teaching processes conducted through SSI, which involve the

social, ethical, and political dimensions of scientific knowledge and are mostly controversial issues with no definitive solutions (Sadler, 2004), enable students to use scientific knowledge in real-life contexts, evaluate different perspectives, and develop evidence-based decision-making skills (Zeidler et al., 2005). Showing students, that scientific knowledge is not abstract and context-free but directly related to life concretizes scientific literacy's social dimension and increases their learning motivation and interest (Sadler & Zeidler, 2009; Zeidler & Nichols, 2009). In addition, from the teachers' perspective, SSI is an essential pedagogical tool for integrating lessons with contemporary issues and keeping students' interest alive.

A review of the increasingly widespread SSI literature in recent years reveals numerous studies on the functions and contributions of socio-scientific based teaching in cognitive, affective, and social dimensions (Eastwood et al., 2012; Klosterman & Sadler, 2010; Lee & Erdoğan, 2007; Lee et al., 2012; Levinson, 2006; Osborne et al., 2004; Ratcliffe & Grace, 2003; Sadler, 2011a; Sadler et al., 2016; Sadler & Zeidler, 2005; Saunders & Rennie, 2013; Venville & Dawson, 2010; Zeidler & Nichols, 2009; Zeidler et al., 2005). The results of these studies indicate that SSI:

- Improves understanding of scientific concepts and ideas
- Enhances understanding of the nature of science
- Develops higher-order thinking skills
- Enhances decision-making and problem-solving competencies
- Increases motivation for science learning
- Strengthens moral reasoning, ethical sensitivity and sense of responsibility
- Supports democratic citizenship and social participation skills.

SSI often involves uncertainty, competing interests, and value conflicts, requiring students to evaluate multiple perspectives, develop evidence-based arguments, and engage in debate. This process fosters higher order thinking skills, including critical, analytical, and creative thinking and argumentation. The ability to make informed choices on climate policy, energy, or healthcare issues depends on weighing scientific data alongside societal values. SSI-based teaching thus enhances students' capacity to address complex problems without a single correct answer. Topics like genetic engineering, artificial intelligence, and environmental sustainability also allow students to consider ethical implications, balance individual and societal interests, and make morally informed judgments, supporting their development as conscious, critical, and responsible citizens. Based on the characteristics of the competencies that should be incorporated into SSI discussions due to the content and nature of SSI and the

competencies targeted for development in SSI training, Table 1 was synthesized to provide recommendations for SSI contexts, educational contributions, and competency development mechanisms.

Table 1.

An Analysis of the Educational Function of SSI

Proficiency	SSI Context	Educational Contribution	Proficiency Development Mechanism Recommendations
Critical thinking	Uncertainty, conflicting information, and multiple perspectives	Objectively evaluating claims and evidence	Questioning scientific data, media, and authority discourses
Creative thinking	Problems without definite solutions that require innovation	Generating alternative solutions	Creating possible future scenarios
Argumentation	Controversial situations and value conflicts	Establishing claim-evidence-reasoning chains	Presenting arguments, analyzing counterarguments, defending one's position
Analytical thinking	Multidimensional (scientific, economic, ethical, political) issues	Classifying data, establishing cause-effect relationships	Breaking down problems into subcomponents, interpreting reports and statistics
Decision making	Societal problems requiring solutions	Developing evidence-based decisions	Comparing different options and selecting the most appropriate solution
Problem solving	Open-ended issues awaiting solutions	Seeking systematic solutions to complex problems	Developing hypotheses and testing solution methods

Proficiency	SSI Context	Educational Contribution	Proficiency Development Mechanism Recommendations
Ethical sensitivity	Ethical dilemmas	Recognizing ethical consequences	Balancing personal values with social ethics
Sense of responsibility	Social impacts of individual decisions	Understanding the consequences of personal choices	Developing sensitivity toward the environment, society, and future generations
Democratic citizenship	Pluralism and diverse perspectives	Respecting different viewpoints	Demonstrating tolerance, equal participation, and compromise in discussions
Social participation	Taking collective rather than individual action	Developing active citizenship skills	Participating in environmental campaigns and creating social projects

When the context for associating the competencies listed in Table 1 with SSI is examined, it is seen that they align with the skills desired for individuals, especially in the 21st century. This enhances the educational value of SSI and reinforces the need to include SSI and its teaching in teacher education.

3.2 Why Should SSI be Included in Teacher Education

The transfer of SSI to the classroom is possible only if teachers possess the knowledge, awareness, and pedagogical skills necessary for such issues. Therefore, systematically incorporating socio-scientific issues into teacher education will strengthen the quality of teaching and the sustainability of democratic societies. Teachers are crucial in shaping students' thinking styles, values, and understanding of social responsibility toward science.

Including socio-scientific issues in teacher preparation programs not only equips prospective teachers with scientific knowledge but also fosters higher-level skills such as critical thinking, ethical reasoning, argumentation, and an understanding of the nature of science (Sadler, 2011a). Such an educational process positions the teacher not only as a conveyor of knowledge but also as a guide who facilitates students' scientific thinking processes. When discussing an example of SSI, such as genetic engineering or environmental sustainability, prospective teachers learn

to evaluate the social boundaries of science, the tensions between economic interests and ethical principles, and diverse perspectives. This process also transforms teachers' epistemological beliefs; It develops the ability to view knowledge not as absolute, but as a contextual and contested phenomenon (Zeidler et al., 2005).

This transformation is also reflected in society through teacher education. SSI equips individuals with scientific knowledge and aims to transform them into active, participatory, and responsible citizens. This impact spreads throughout society through the students educated by teachers trained with this purpose. As Levinson (2010) points out, democratic participation is weakened unless contemporary education systems center on a science-related understanding of citizenship. SSI enables teachers to convey this kind of citizenship to their students. Thus, the classroom becomes a social microcosm where different perspectives are respectfully discussed, evidence-based thinking is embraced, and empathic communication is established. These skills enhance the quality of science education and social life, a point frequently emphasized in global education policy and performance reports.

Institutions such as the Organization for Economic Cooperation and Development (OECD) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) contain numerous statements in their international education monitoring and evaluation reports, under topics such as the social dimension of scientific literacy, education for sustainable development, critical citizenship, and complex problem-based learning, which connect with the fundamental principles of SSI and strengthen its place in education. For example, regarding the social dimension of scientific literacy, the OECD's definition of scientific literacy within the Programme for International Student Assessment (PISA) framework directly aligns with the SSI: "*Scientific literacy is the ability to engage with science-related issues, and with the ideas of science, as a reflective citizen*" (PISA 2018 Framework, OECD, 2019, p. 100). This definition aims to enable individuals to use scientific knowledge to make informed decisions on current societal issues, which is the essence of SSI. We see these and similar explanations, which establish a context for SSI, in the OECD's Teaching and Learning International Survey (TALIS) (Ainley & Carstens, 2018), Programme for International Student Assessment (PISA) (URL-1), UNESCO's Global Education Monitoring (GEM) Report (URL-2), Education for Sustainable Development (ESD) (URL-3), Frameworks, and Institute for Statistics (UIS) (URL-4) reports. In these reports, it can be said that SSI is situated within the development of 21st-century skills under dimensions such as the transformative role of teachers, sustainable development and ethical dimensions, evidence-based decision-making, and preparation for

uncertainty and value conflicts, in addition to the social dimension of scientific literacy. The common goal of these reports is to educate students as active citizens who use scientific knowledge in a social context. This demonstrates that SSI is a key context in teacher education and the curriculum, emerging as a teaching strategy and as the pedagogical expression of a vision of global citizenship and a sustainable future.

Therefore, teacher preparation programs should be enriched with socio-scientific contexts and supported with courses and social responsibility projects that bring science to the center of social life. Studies conducted with preservice teachers (e.g., Espeja & Couso, 2020; Kinskey & Zeidler, 2021; Lee, 2022; Nida et al., 2021; Sibiç & Topçu, 2020; Stouthart et al., 2023) revealed that preservice teachers generally had positive attitudes toward SSI and found it engaging. However, during the implementation process, they experienced issues such as a lack of content and pedagogical knowledge, concerns about how to reveal the nature of science and technology through SSI scenarios, the need to acquire skills to facilitate and support student engagement, limited curricula, insufficient time, and assessment challenges. The common finding of these studies was that preservice teachers' awareness of SSI teaching was high, but their pedagogical practice skills were insufficiently developed or had limitations.

Consequently, the need to strengthen teacher training policies and curricula with innovative approaches centered on SSI has been frequently emphasized in education monitoring and evaluation reports and the literature. SSI will transform teachers' professional identities, deepen students' relationship with science, and contribute to the sustainability of democratic societies. This awareness has led to the development of SSI-related teaching approaches and practices. The following section provides information on SSI teaching approaches and practices.

3.3 Teaching Approaches and Practices of SSI for Prospective Teachers

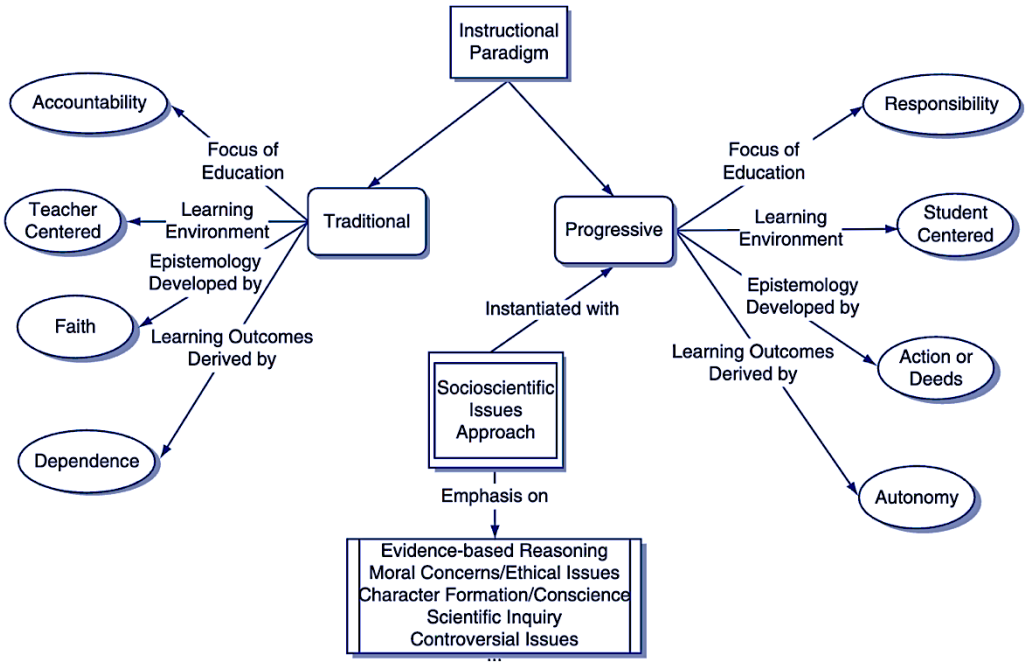
Pedagogical approaches in education have undergone a multi-layered transformation throughout history, ranging from knowledge transfer to individual interpretation, and from cognitive processes to socio-cultural contexts. This transformation demonstrates that learning is not limited to acquiring scientific concepts; it also shapes individuals' thinking, values, and social responsibilities. At this point, SSI has positioned itself at the intersection of current social issues and science, reflecting pedagogical developments. Contemporary pedagogical approaches, which emphasize that teaching must go beyond mere knowledge transfer, encourage students to discuss, make decisions, think critically, and evaluate ethical dimensions;

thus, SSI stands out as a powerful tool that directly aligns with the educational vision of the 21st century. Therefore, we must place SSI teaching on a progressive footing.

Zeidler et al. (2011b) state that many reforms in education have only changed the superficial aspects of school, failing to bring about a profound transformation. However, they emphasize that the transition to the SSI framework cannot be achieved through methodological changes alone; it requires fundamental changes in both teachers' pedagogical understanding and students' conceptual learning and critical/reflective thinking. Researchers highlighting the difference between traditional and progressive teaching argue that the SSI approach is an example of progressive education. They say that the proposed SSI approach requires a profound restructuring of science education and a re-creation of pedagogical reality to achieve goals such as autonomy and responsibility, which are often associated with the progressive paradigm. They describe the paradigmatic position of SSI within the opposition between the two extremes of traditional and progressive teaching paradigms as shown in Figure 1.

Figure 1.

Continuum Contrast of Instructional Paradigms (Zeidler, et al., 2011b, p.279).



In figure 1, the SSI approach has been integrated into the progressive paradigm with its structure related to evidence-based reasoning, moral concerns and ethical issues, character formation and conscience, scientific inquiry, and addressing controversial topics. This situation gives us clues about the strategies and methods we should follow in SSI teaching.

The SSI approach aims to develop students' thinking skills, ethical sensitivity, decision-making competence, and social responsibility considering the progressive paradigm, which progresses through the processes of experimentation, application, and problem-solving, to enable individuals to become independent learners who can make their own decisions and take responsibility.

Simonneaux (2014) emphasizes that we can observe very different goals in the SSI teaching literature and that SSI has many dimensions. He states that the integration of SSI into teaching is shaped according to teachers' perspectives and teaching methods. The researcher maps this situation, explaining it through the metaphor of how much teachers "heat up" or "cool down" these topics, as shown in Figure 2.

Figure 2.

Educational Stakes and Pedagogies Beyond SSI Education (Simonneaux, 2014, p. 8).

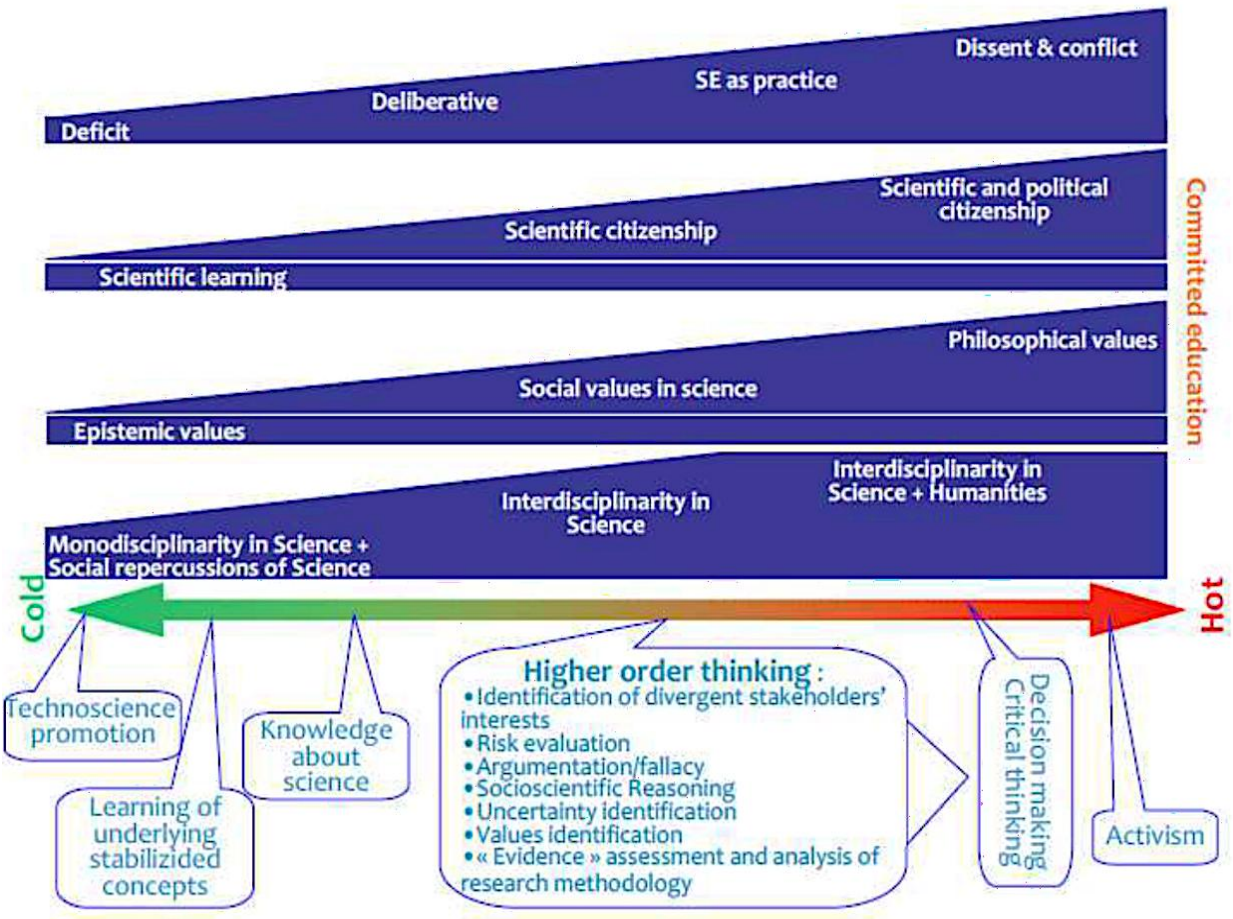


Figure 2 positions the approach to SSI between cold and hot ends. At the "cold end," the integration of SSIs into the curriculum is used to motivate students to learn science, even to

convince them of the benefits of technoscience. At the "hot end" of the continuum, the focus of teaching moves beyond developing conceptual and procedural knowledge of science to nurturing activist commitments among learners. Between these two ends of the continuum lie various educational topics involving the teaching and learning of scientific concepts that can contribute to developing critical thinking. When critical thinking emerges, the focus shifts toward the "hot end." At the "cold end," the knowledge activated in the classroom is single-discipline science. At the "hot end," it is discussed on an interdisciplinary basis between science and the humanities. Here, the multidisciplinary approach transcends social impact, the influence of values, and culture. This approach requires combining knowledge between the humanities and the natural sciences and can often include non-academic knowledge. Values in the teaching of SSI can be explicit or implicit. Only epistemic values can be activated at the 'cold end' (validity, reliability, accuracy). The philosophical principles underlying values are explained and discussed at the' hot end'. Such a focus aims to help students identify the values of different stakeholders and their own values in decision-making processes. Beyond science learning, the challenge may be to develop scientific and political citizenship, thus leading to a convergence of science education and political education and, consequently, scientific and even political literacy development.

Simonneaux's proposed model can also be matched with levels of scientific literacy. The warm end represents multidimensional literacy, while the cold end represents conceptual and procedural literacy. Classroom teaching practices can be shaped according to the degrees of warmth on this spectrum. Factors such as the class level, the students' readiness, and the socio-scientific topic's multidisciplinary nature will affect the warmth. Teachers are expected to create the ideal educational situations appropriate to the nature of SSI, where the temperature is kept high.

Zeidler (2014, p. 69) emphasizes that the ideal use of the SSI framework should include the following basic elements that form a sociocultural philosophy for developing scientific literacy:

- Utilize personally relevant, controversial, and ill-structured problems that require scientific, evidence- based reasoning to inform decisions about such topics.
- Employ the use of scientific topics with social ramifications that require students to engage in dialogue, discussion, debate, and argumentation.
- Integrate implicit and/or explicit ethical components that require some degree of moral reasoning.
- Emphasize the formation of virtue and character as long-range pedagogical goals.

To effectively transfer these fundamental elements into the classroom environment, the teaching process must be planned consistently with the nature of SSI. The literature contains numerous models and approaches that facilitate the transfer of SSI to classroom teaching practices (Keefer, 2003; Krajcik et al., 2008; Levinson, 2006; Presley et.al, 2013; Ratcliffe, 1997; Ratcliffe & Grace, 2003; Sadler, 2011b; Yadav et al., 2007; Zeidler et al., 2011). When reviewing the relevant studies, the following approaches are used in integrating SSI into lessons:

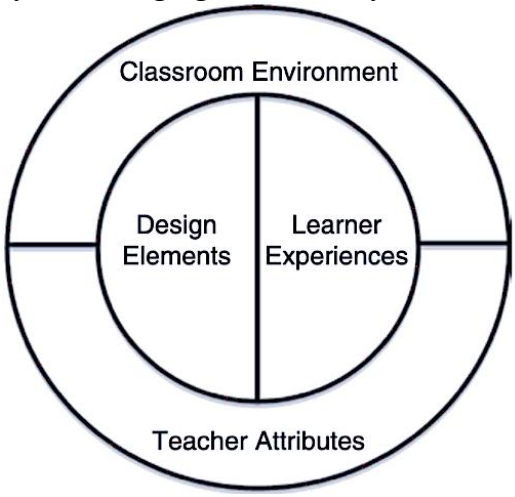
- Contextual and situational learning
- Argumentation-based learning
- Decision-making models
- Inquiry-based learning
- Collaborative and dialogic approach
- Scenario-based learning
- Problem-based learning
- Project-based learning
- Digital tools and media-based learning

are prominent. These teaching approaches and models are established instructional processes. The key distinction of SSI-based teaching is its direct connection to society and engagement with controversial, dilemma-rich topics. Once this link is established, instruction follows the principles of the chosen approach or model. Techniques such as concept cartoons, prediction-observation-explanation (POE), role-playing, brainstorming, and mind mapping can support this process. Some models provide step-by-step guidance for integrating SSI, while others offer flexible frameworks that allow teacher discretion.

Including some frameworks developed for SSI teaching to guide its integration into lessons is useful. Sadler's (2011b) framework for SSI-based education, which occupies an essential place in the SSI literature, consists of four key elements: design elements, student experiences, classroom environment, and teacher qualities. A graphical representation of Sadler's SSI Teaching Framework is shown in Figure 3.

Figure 3

Graphical Representation of the Emerging Framework for SSI-Based Education (p.362)



Design elements highlight the key components of effective SSI-based education. Student experiences indicate the kinds of learning opportunities students should have. The classroom environment refers to the contextual features that support these experiences, while teacher attributes describe the qualities and practices needed for successful implementation. The model's design elements and student experiences are centrally positioned to emphasize their core role. In contrast, the classroom environment and teacher attributes are placed peripherally to show how they shape implementation. The main characteristics of these elements are outlined below.

Basic Design Elements

1- Designing an instructional process around an engaging topic

2- Presenting the topic primarily

3- Providing an environment for practicing higher-order thinking skills

4- Providing students with a culminating experience

Recommended Design Elements

5- Use media to connect classroom activities to the "real world."

6- Use technology to facilitate student learning experiences

Essential Learning Experiences

1. Reasoning, argumentation, decision-making, and position-taking

2. Accessing/encountering relevant scientific ideas and theories

3. Collecting and analyzing relevant scientific data

4. Facilitating discussions about the social dimensions (political, economic, etc.) of the topic

Suggested Learning Experiences

5. Confront the ethical dimensions of the topic

6. Evaluate the nature of the science themes related to the topic

Essential Characteristics of the Classroom Environment

1. High student engagement

2. Collaborative and interactive

3. Teachers and students respect each other

4. Teachers and students feel safe and comfortable in the classroom environment

Essential Characteristics of Teachers

1. Knowledge and awareness of the relevant SSI topic

a. Knowledge of relevant science content

b. Awareness of relevant social issues

2- Honesty regarding knowledge limitations

3- Willingness to teach controversial topics in the classroom

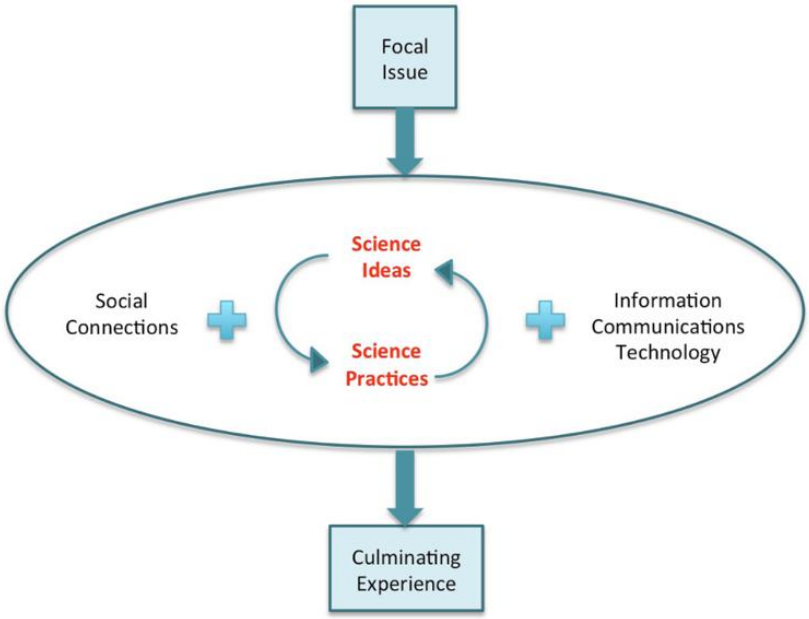
4- Contribute to discussions rather than acting as an authority figure in the classroom

Sadler's framework guides teachers by encompassing all dimensions of the teaching environment. This framework provides teachers with information about their role in teaching SSI and guidance on shaping the classroom environment, what to expect from students, and how to design learning situations.

One of the models discussed here belongs to Friedrichsen et al. (2016). The model developed for teaching SSI is believed to be helpful in teachers' lesson planning by relating it to the stages of the 5 E Learning Model. The infographic for the relevant model is presented in Figure 4.

Figure 4.

Friedrichsen's SSI Teaching Model (p.3)



The instructional model begins with a focal point, the defining feature of SSI-based teaching. It emphasizes starting with an engaging topic to contextualize learning. The model includes three interactive elements central to students' experiences: social connections, scientific ideas and practices, and information and communication technology (ICT). Students are encouraged to apply scientific concepts and practices, explore the social complexities of the topic, and use ICT to access, analyze, and share information. The model concludes with a synthesis activity where students integrate their learning across these three dimensions. Its alignment with the 5E model is shown in Table 2.

Table 2.

Intersection of SSI and 5E Model (Friedrichsen et al., 2016, p.3)

SSI Model	**5E Model**
Focal issue	Engagement: Engage students with topic and assess students' ideas related to topic
Social Connections + **Science Ideas and Practices** + Information Communication Technology	Exploration of phenomenon
	Explanation: Developing a scientific explanation
	Elaboration: Apply scientific explanation in a new context
Culminating Experience	Evaluation

Friedrichsen's SSI teaching model largely overlaps with the structural logic of the 5E model but deepens each stage in a way specific to the socio-scientific context. The focal issue stage in the model parallels the engagement stage of the 5E, but here, the goal is to capture students' attention and make them recognize a social and ethical problem. The social connections, science ideas and practices, and ICT components integrate the exploration, explanation, and elaboration stages of the 5E; students develop data-based explanations using scientific processes, apply these explanations to social contexts, and relate them to different perspectives. Finally, the culminating experience stage overlaps with the evaluation stage of the 5E. Still, it encompasses cognitive assessment, students' ethical reasoning, argumentation competencies, and awareness of science-society interactions.

The models of Sadler (2011b) and Friedrichsen (2016) are shared here to guide educators. However, it is undoubtedly possible to multiply the frameworks/models related to SSI teaching. Recommended readings on other frameworks/models include Saunders and Rennie's (2013) Pedagogical Model For Ethical Inquiry, which focuses on understanding subject knowledge, ethical inquiry, and decision-making in relation to SSI, and Levinson's (2006) Epistemological Model for establishing connections between knowledge and justification, understanding and respecting different views, and becoming a democratic individual, and Keefer's (2003) Decision Making Models for moral reasoning and decision-making.

When addressing SSI in teacher education, it is considered necessary not to remain theoretical but to provide teaching processes experienced firsthand by teacher candidates. For this reason,

the flow includes explanations and sample lesson scenarios related to context-based and argumentation-based learning, which are frequently used to integrate SSI into the course.

Contextual and situational learning sample: Context-based teaching involves presenting and linking a real-world topic to conceptual science learning. Real-world contexts can include products, situations, or events, helping establish connections between daily life, communication, and scientific literacy. Unlike traditional content-focused approaches, where application comes last, context-based learning emphasizes applying concepts within relevant real-life situations (Holbrook & Rannikmae, 2017).The socio-scientific teaching approach, which focuses on context-based learning, proposes a more relevant behavioral approach to relate the context to a real-life problem or issue, rather than initiating a context-based approach through a science-related theme or field. Both a real-world problem and a real-world topic can be related to learning scientific knowledge, and both can serve as the focal point for a context-based approach (Holbrook & Rannikmae, 2017).

Sample Lesson Scenario: Single-Use Plastics and the Ban Debate

Scientific knowledge: How long it takes for plastics to decompose in nature, the effects of microplastics on marine life

Social dimension: Employment provided by the plastics industry, the cost of alternative products

Environmental dimension: Amount of waste, recycling rates

Learning outcomes:

- Explains the effects of single-use plastics on nature and living organisms.
- Evaluates the views of different actors on the plastic ban.
- Develops feasible solutions at the local level.

Teaching method: Case study

Teaching material: Current news clippings, materials such as tables showing the decomposition times of plastics in nature, visuals, and videos showing the effects of microplastics on living things.

Process:

- The sample news article that sets the context is examined in class as a case study, like the teaching material section.
- At the end of the case study, large or small group discussions are held in class on questions analyzing the event. Care is taken to ensure the questions relate to scientific knowledge, social, and environmental dimensions.
- At the end of the discussion, students are directed to develop a project on a local scale.

Assessment: Participation in group discussions, the level to which students support their decisions with scientific data, and the diversity and feasibility of their proposed solutions are assessed.

Argumentation-based learning sample: Toulmin (2003) defines argumentation as supporting claims with reasons and evidence. Jimenez-Aleixandre and Erduran (2007) highlight its integral role in science and science education, encouraging classroom implementation. Researchers emphasize that recognizing the potential controversy of claims, including in basic science contexts, is essential for meaningful participation in scientific and socio-scientific debates. Due to the contentious nature of SSI, argumentation-based teaching models are readily applicable in classrooms, with Toulmin's Argument Model (2003) and Walton's Argument Schemes (1996) being the most common. Regardless of the model, techniques such as statement tables, concept maps, concept cartoons, competing theories, and prediction-observation-explanation are practical (Erduran, 2007).

Sample Lesson Scenario: The use of GMO products in agriculture: Arguments are competing!

Scientific information: GMOs (Genetically Modified Organisms) are products developed by modifying their genetic structure using biotechnological techniques.
Social dimension: The role of GMOs in combating food security and hunger issues, public perceptions: Health concerns, trust in technology, etc.
Environmental dimension: The risk of gene transfer from GM plants to wild species (decrease in biodiversity), the development of resistance to some GMOs
Political dimension: Political and economic pressure from multinational seed companies, biosafety laws, and restrictions on GMO imports

Learning outcomes:
- Conclude the effects of GMOs on the environment and health.
- Develop evidence-based arguments regarding the use of GMOs.

Teaching method: Walton's argument scheme

Teaching material: Articles, videos, concept cartoons, scenario examples, etc., reflecting different perspectives on GMOs.

Process:
- Focus on the topic is achieved using stories containing different scenarios, concept cartoons, news texts, etc.
- Three perspectives are identified: "agricultural productivity, environment and health, economic and political."
- Students are divided into three groups based on these perspectives.
- Each group creates Walton's argumentation scheme (causal relationship, factual proposition, conclusion) appropriate to their perspective.
- After listening to each other's propositions and cause-effect relationships, the groups and the teacher prepare critical questions, which are the final stage of the scheme, and direct them to the groups.

Assessment: Assessment is based on the consistency of causal relationships, the quality of arguments, the consistency of answers to critical questions, and the level of competence.

4. Conclusion

In this section, we saw that SSI plays a critical role in the contemporary understanding of scientific literacy by enabling students to integrate scientific knowledge with ethical, political, and social dimensions (Sadler, 2011a). However, reflecting this potential in educational practices is not merely a pedagogical issue; it is also a multidimensional issue directly related to educational policies, curricula, teacher competencies, and teacher training processes, and it still presents challenges.

Ratcliffe and Grace (2003) emphasize that SSI is generally addressed in national curricula in a limited and superficial manner, confined to the natural sciences. For example, while some socio-scientific topics, such as environmental issues and biotechnology applications, are addressed in teaching programs in Turkey, their discussion and ethical dimensions are mostly overlooked. However, the interdisciplinary nature of SSI requires that the subject be addressed in a multidisciplinary manner and at a multidimensional level of scientific literacy. For this reason, SSI must be positioned in curricula as content and in a context that develops higher-order thinking skills (Sadler, 2009). This is only possible with the guiding role of education policies.

At this point, the primary function of policymakers should be to redefine the objectives of teaching programs in a way that explicitly emphasizes reasoning using scientific knowledge in social, ethical, and political contexts (Zeidler, 2014). Furthermore, it is necessary to move beyond exam-focused assessment systems and promote open-ended questions, discussion-based tasks, and performance assessments that measure skills such as argumentation and decision-making (Sadler, 2009). This transformation will also make it easier for teachers to devote time to discussion and problem-solving in the classroom within the context of SSI. Another critical function at the policy level is to support teachers' professional development. In this context, teachers should be provided with continuous training opportunities related to SSI-based pedagogical practices (Evagorou & Dillon, 2011). Training on SSI-based teaching should be prioritized in pre-service and in-service teacher education. Research shows that teacher candidates receive limited preparation in SSI pedagogy (Topcu, 2010), teachers generally have a partially informed understanding of SSI-based teaching (Chen & Xiao, 2021), teachers express concerns about the controversial aspects of topics in SSI teaching (Borgerding et al., 2018), teachers encounter many challenging issues when addressing socio-scientific topics in their lessons, such as restructuring classroom dynamics and culture and supporting student participation in socio-scientific issues (Lee & Yang, 2019), and that teachers need

comprehensive knowledge and skills regarding the inquiry procedures that should be used in their lesson plans addressing socio-scientific issues (genetics-themed) (Ngwenya & Mavuru, 2021).

Teacher education should equip candidates with argumentation and ethical reasoning skills through discussion, role-playing, case analysis, microteaching, discussion simulations, media analysis, and online intercultural collaboration on local and global SSI issues (Simonneaux, 2014). Interdisciplinary modules integrating science and social science perspectives can enhance SSI teaching effectiveness. Expanding SSI content and time in teacher education addresses teachers' common lack of pedagogical content knowledge in SSI (Evagorou & Dillon, 2011). Challenges remain in assessing student learning in SSI, and teachers may face conflicts between their views and students, requiring careful management of scientific knowledge alongside value-oriented learning processes (Levinson, 2006).

By its very nature, SSI intersects with ethical, religious, and cultural values, bringing with it social sensitivities. For example, genetic engineering or nuclear energy topics can create social polarization (Reis & Galvao, 2004). Christodoulou and Osborne (2014) emphasize that these tensions also present opportunities for developing democratic citizenship skills. However, teachers must also be competent in conflict management and value-based pedagogies to capitalize on this opportunity.

In summary, the potential of SSI in education can be realized not only through content additions but also through the coordinated strengthening of the curriculum, policy, teachers' pedagogical equipment, social context, and teacher training processes. Therefore, policymakers, curriculum developers, and teacher educators must develop a shared vision to sustainably implement the democratic and scientific literacy contributions offered by SSI.

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CHAPTER 5

Instructional Technologies

Hüseyin KARAASLAN

- The rapid evolution of educational technologies has resulted in technologies from the previous decade now being considered traditional.
- Artificial intelligence has created numerous opportunities for teachers, students, and school administrators in education.
- Educational technologies span both the systemic and individual spectrum.
- The widespread adoption of educational technologies has provided substantial benefits to education while also introducing risks, including potential ethical violations.

Introduction

The purpose of this book chapter is to discuss the topic of instructional technologies in teacher education. For this purpose, a broad conceptual introduction to instructional technologies has been presented. Subsequently, instructional technologies in teacher education have been addressed. Unlike traditional instructional technologies, this classification includes categories such as artificial intelligence tools, learning management systems, learning analytics, mobile learning, virtual reality, e-books, and social media tools. For each category, relevant literature is discussed, and studies using these technologies are presented. Recognized representative tools and their access information are provided, along with examples that clarify the functional features of each tool and indicate whether payment is required. Furthermore, specific examples illustrate how these tools are applied in teacher education. These examples illustrate diverse scenarios, from homework to exams. However, for tools such as e-books and virtual reality, for which numerous examples can be easily found, only guidance has been provided. In general, this chapter aims to provide guidance for all those interested in teacher education by offering a resource for teacher educators and prospective teachers to effectively integrate instructional technologies into the educational process.

1. Theoretical Framework

This section provides general information about instructional technologies and discusses their usability in teacher education. Instructional technologies are categorized into two main types: traditional and innovative. To discuss the literature on innovative instructional technologies and present examples related to teacher education, these technologies are examined in terms of their areas of use, payment status, and functions within the context of teacher education.

1.1 Traditional Instructional Technologies

The rapid advancement of technology can, over time, lead to certain technologies being labeled as "traditional." Today, many innovative instructional technologies, particularly artificial intelligence tools, have rendered numerous tools that were integrated into instructional processes over the past decades, "traditional" as well. When traditional instructional technologies are mentioned, one may think of products that have become permanently established within the field, are widely used, and whose use is commonly recognized. Among these, projection devices, computer-based presentations, multimedia devices capable of playing audio and video, and smart boards can be cited as examples. Research concerning these technologies has reached a considerable extent in the literature. In the field of education, numerous tools can now be identified that may be considered new, including learning management systems, learning analytics, mobile learning, and social media. Compared to traditional tools, these tools are relatively new; therefore, the knowledge regarding their use is limited. Applied research and guidelines are needed to inform data on the use of new teaching technologies, their limitations and advantages, and their long-term effects.

1.2. Innovative Instructional Technologies

Unlike traditional instructional technologies, the concept we define as new instructional technologies refers to tools for which a common framework of use has not yet been established, which are highly functional, and which make intensive use of technology. Among these tools, some, such as e-books and virtual reality, can be directly applied in the classroom, while others, including blockchain, learning analytics, and learning management systems, are related to the structural system of the instructional process. For this purpose, the discussion of instructional technologies in this study will proceed within the framework of the following headings.

- Artificial intelligence tools
- Learning analytics
- Gamification technologies
- Z-Book
- Learning management systems
- Mobile learning
- Virtual reality
- Social media

1.2.1. Blockchain and education

Blockchain can be defined as a public ledger. The data uploaded to the system is stored on the computers of all stakeholders within the system. For each new user, a new block is added to the system. In this way, a decentralized structure is formed. In addition, permanence and anonymity are among the system's most significant features (Zheng, Xie, Dai, Chen, & Wang, 2017). Although blockchain technology has recently gained widespread adoption in the field of education, it can be said that progress in this area has been slow. There are possibilities for use in a wide range of areas, including e-transcripts, digital documents, student admissions, library systems, evidence of extracurricular learning, alumni information systems, and intellectual property protection (Bhaskar, Tiwari, & Joshi, 2020). Another study has exemplified areas of use such as the reliability of collaborative learning systems, lifelong learning systems, and educational competitions (Alammary, Alhazmi, Almasri, & Gillani, 2019, p. 7). It is difficult to directly relate blockchain technology to teacher education. Rather, blockchain technology is concerned with a general system that encompasses teacher education. Most of the time, it is not directly a subject of classroom practices but is instead related to preserving and safeguarding metadata. Nevertheless, it may be beneficial for institutions engaged in teacher education to leverage this technology.

1.2.2. Artificial intelligence

Just as technology has permeated every aspect of life, it has also extended into education. Teaching and learning processes make intensive use of technological opportunities. With the widespread adoption of artificial intelligence tools, particularly in recent years, the

potential to benefit from these opportunities has increased. As Sandhu, Channi, Ghai, Cheema, & Kaur (2024) notes, the integration of artificial intelligence tools into education has occurred rapidly, to the extent that a distinction has emerged between traditional artificial intelligence tools and generative artificial intelligence tools. The integration of artificial intelligence into education carries the promise of making education more adaptable, inclusive, and effective (Ayeni, Al Hamad, Chisom, Osawaru, & Adewusi, 2024, pp. 261–262). A substantial body of research exists concerning the opportunities presented by integrating artificial intelligence into education. For students, the most important of these is that it invites them into collaborative learning. For teachers, it contributes by assisting them with administrative tasks and grading, thereby allowing them to create more time for teaching (Tahiru, 2021, pp. 15–16). In their study, Chen, Chen, and Lin (2020) concluded that the use of artificial intelligence in education enriches and enhances the quality of the educational process. Artificial intelligence can also contribute to providing individuals with free and personalized learning pathways as well as supporting their self-regulation skills. It helps teachers to better understand students' needs and to deliver a more foresighted instructional process (Seyrek, Yıldız, Emeksiz, Şahin, & Türkmen, 2024, p. 846). At the same time, the benefits of artificial intelligence in relation to the affective dimension of education have also been the subject of research. Çavuş (2024) conducted a study on the use of artificial intelligence tools for assessment and evaluation purposes. The study indicated that the use of artificial intelligence in assessment and evaluation enables teachers to save time, while also emphasizing the necessity of developing artificial intelligence tools required for a fair assessment and evaluation process.

In their analysis on the use of ChatGPT in education, Kutlucan and Seferoğlu (2024) shared findings suggesting that the use of this application may reduce students' learning anxiety. The integration of artificial intelligence into education not only focuses on students and teachers but also extends to various domains, including the learning environment, instructional approach, and target audience (Arslan, 2020, p. 86). Researchers, such as Gündüz (2023), have noted that artificial intelligence contributes to the gamification of education. The integration of artificial intelligence into education has become a necessity due to the increasing prominence of artificial intelligence technologies in human life (Casal-Otero et al., 2023, p. 1).

There are numerous examples regarding the roles of artificial intelligence in teacher education. These include improving the quality of teacher education, fostering teaching skills, enabling personalized learning, providing access to quality resources, identifying gaps in learning and learning styles, and supporting adaptive learning (Jamal, 2023). Research addressing the issue

of artificial intelligence literacy in teacher education has recently gained momentum. The literature emphasizes that researchers in educational sciences should engage with and define artificial intelligence in the context of teacher education, that teachers should be at the forefront of efforts to develop AI literacy, and that teachers' AI literacy should be analyzed (Sperling et al., 2024).

1.2.2.1. Artificial intelligence literacy

Similar to literacy in a classical sense, artificial intelligence literacy has become a skill that everyone needs to acquire in order to respond to the age of artificial intelligence (Ng, Leung, Chu, & Qiao, 2021a, p. 1). However, since artificial intelligence literacy is a relatively new concept, only a limited number of studies have provided a comprehensive definition (Ng, Leung, Chu, & Qiao, 2021b). The Ministry of National Education (MEB, 2024) has published a guide to contribute to the artificial intelligence literacy of teachers. This guide provides a detailed explanation of the artificial intelligence tools available for use in education, organized by subject area. Artificial intelligence literacy rests upon the conscious use of artificial intelligence tools. For this, it is necessary to recognize artificial intelligence tools, adopt their functions, and adhere to ethical principles. Discussions related to artificial intelligence and ethics have increased in recent years and are addressed in the following section.

1.2.2.2. Artificial intelligence and ethics in education

The literature emphasizes the need for studies that address the ethical and legal appropriateness of using artificial intelligence applications in education (İncemen & Öztürk, 2024, p. 44). The unpredictable development of artificial intelligence has also raised questions about what ethical principles should govern its use. This has introduced the concept of trustworthy artificial intelligence into the literature. To establish trustworthy artificial intelligence practices that are sensitive to ethical principles, administrative, political, academic, and technical measures must all be taken (Efe, 2021, p. 18). Just as artificial intelligence, in a sense, imitates natural intelligence, it should also imitate natural ethics. For this, responsibilities toward humans must be integrated into artificial intelligence systems (Çelebi & İnal, 2019, p. 661). The fact that artificial intelligence can involve positions related to data privacy, anonymity, and document generation (Maral, 2024, p. 2024) necessitates a meticulous process regarding its use in educational applications. Indeed, documents produced by students or other stakeholders in education through artificial intelligence may appear convincing in terms of authenticity. The necessity of carefully protecting the privacy and anonymity of data stored in

educational information systems is another area where artificial intelligence intersects with ethics in education. Öztürk Dilek (2019) raised the question, *Who holds responsibility when an error is committed by artificial intelligence?*, a consideration that is equally relevant in the context of education. In learning processes that are made autonomous through AI systems, if learning occurs incorrectly or other problems arise, it would not be appropriate to hold artificial intelligence solely responsible.

2. Artificial Intelligence Tools That Can Be Used in Teacher Education

Under this heading, artificial intelligence tools suitable for educational use are listed. Numerous studies have compiled such lists (Ruiz-Rojas, Acosta-Vargas, De-Moreta-Llovet, & Gonzalez-Rodriguez, 2023). In this section, however, the focus will be on how these tools can be utilized specifically within the context of teacher education.

Table 1.

Artificial Intelligence Tools That Can Be Used in Teacher Education

Tool	Definition	URL
ChatGPT	It is a language model, and its use is easy to learn. It can be employed in various areas, such as responding to students' and teachers' research inquiries, organizing data, conducting analyses, and generating research questions. Its basic plan is free of charge. It can be used to help prospective teachers develop skills such as preparing lesson plans, designing research, and creating assessment and evaluation tools.	https://chatgpt.com/
Gamma:	It offers areas of use in many domains, such as creating slides, designing documents, and designing websites and social media content. A free trial version is available. It can be used by prospective teachers for lesson presentations and designing instructional materials.	https://gamma.app/
Prezi AI:	Unlike the classic Prezi, this version uses artificial intelligence to generate presentations. Free options are also available. It can help prospective teachers prepare creative and visually impressive presentations.	https://prezi.com/

Diffit:	This tool, developed for teachers, allows for the revision of a text by adjusting it to the student's level. In addition, it is capable of generating lesson materials. It helps prospective teachers develop instructional materials suitable for students at different levels. It also has the potential to contribute to prospective teachers' awareness of the differences among student proficiency levels.	https://web.diffit.me/
Canva AI	Products created with Classic Canva can be supported by the artificial intelligence support module. In this way, it has become an application where design can be carried out with the assistance of artificial intelligence. It can be used to help prospective teachers develop their skills in producing visual content such as instructional materials, posters, and activity sheets.	https://www.canva.com/ai-assistant/
Grammarly:	It is a language editing application that helps improve texts with the support of artificial intelligence. A free plan is available. It can be used by prospective teachers to enhance their academic writing.	https://www.grammarly.com/
TalkPal AI:	It is a language learning application that aims to help users acquire language learning skills through artificial intelligence-supported content covering all language skills. A free plan is also available. Prospective teachers can use it for both their own language development and learning language teaching methods.	https://talkpal.ai/
Microsoft Copilot:	It is an artificial intelligence tool integrated into Microsoft Office applications. It is designed to assist users in utilizing these applications. Considering that such tools are frequently used in education, it can be regarded as one of the artificial intelligence tools applicable in educational contexts. Microsoft Office applications generally offer special plans for schools. It supports prospective teachers in areas such as time management, content creation, and data analysis within MS Office applications.	https://copilot.microsoft.com/
Claude:	It is an artificial intelligence tool generally used for tasks related to texts. It offers features such as summarizing lengthy texts,	https://claude.ai/

	generating reports, and providing academic support. A free plan is available. It can support prospective teachers in assignments, articles, or thesis work by assisting with language support, text summarization, and argument development.	

3. Learning Analytics That Can Be Used in Teacher Education

The concept of analytics is an umbrella term that encompasses the use of data, analysis, or models to gain insights and take action in a complex field. Learning analytics is a type of analytics that enables learners to perform at their best. In a system where the process is monitored through learning analytics, educators are alerted when intervention is needed, input is provided for course design, and learning is personalized. A robust instructional technology is essential for learning analytics, since the system must possess strong technology and planning infrastructure to analyze both inputs and outputs (Brown, 2012). The primary purpose of learning analytics is to improve learner performance. To achieve this, learning analytics operates within a structure that involves continuously receiving feedback from the learning process and intervening when necessary. This structure becomes possible through the use of learning analytics technologies (Tutsun, 2020). Salas-Pilco, Xiao, and Hu (2022) emphasized that learning analytics provides significant support for prospective teachers in optimizing the instructional process, predicting learning pathways, and forecasting learning outcomes. It has been particularly highlighted that a learning analytics approach combined with artificial intelligence becomes a powerful tool for enriching students' experiences.

Learning analytics also have a wide range of applications in teacher education. In this context, Montgomery, Mousavi, Carbonaro, Hayward, and Dunn (2019) employed learning analytics in the education of music teacher candidates, while Moon, Yeo, Banihashem, and Noroozi (2024) applied it in the education of mathematics teacher candidates.

In teacher education, learning analytics can be used to monitor prospective teachers' professional development, track the products they create during their training, personalize their education, and enhance their teaching skills. For example, analyzing lesson plans prepared by teacher candidates, classroom activities, or their interactions in digital learning environments reveals which pedagogical strategies they employ more successfully and in which areas they need support. In this way, learning analytics holds significant potential to contribute not only to the academic knowledge of teacher candidates but also to the improvement of their practical teaching skills. Due to these advantages, learning analytics can be considered an important

instructional technology that can be applied in teacher education. Some learning analytics tools that can be used in teacher education are as follows:

Table 2.

Learning Analytics That Can Be Used in Teacher Education

Tool	Definition	URL
IntelliBoard	This tool includes features such as monitoring student performance, tracking learning objectives, and predicting risks, which can be useful for academics working in the field of teacher education. In this way, the professional development of prospective teachers can be effectively monitored. A demo version of this tool is also available.	https://intelliboard.net/
Civitas Learning	It is a learning analytics tool developed for universities. With this tool, students can be monitored individually or in groups. Supported by artificial intelligence, it tracks student performance and provides users with analysis results. A demo version is available.	https://www.civitaslearning.com/
Instructure	It is an artificial intelligence-supported learning analytics tool integrated with learning management systems. Its main features include real-time tracking of students' progress and instant notifications, powered by artificial intelligence, about students who are struggling. The tool offers extensive customization options according to institutional needs and has specifically included higher education within its scope. A free trial version is available.	https://www.instructure.com/

4. Gamification Technologies That Can Be Used in Teacher Education

The concept of game-based learning and gamification is a rapidly growing phenomenon in the literature. Game-based learning refers to the use of games for educational purposes, whereas gamification involves incorporating game elements into educational processes (Caponetto, Earp, & Ott, 2014). Specifically, gamification tasks often include resource

collection, storytelling, points, badges, and levels (Albayrak Özer, 2022, p. 80). Studies indicate that gamification is generally applied to enhance participation, motivation, and achievement. While widely used in universities, gamification also spans the full spectrum of education, from early childhood to vocational training (Zeybek & Saygı, 2024). For example, Svanberg and Bergh (2023) have experimentally demonstrated that employing gamification in teacher education contributes positively to success. Similarly, Flores-Aguilar, Prat-Grau, Fernández-Gavira, and Muñoz-Llerena (2023) reported that gamification supports the transfer of subjects in teacher education. Taken together, these studies naturally raise the question of which gamification applications can be used in teacher training. Some of these are shown in Table 3.

Table 3.

Gamification Technologies That Can Be Used in Teacher Education

Tool	Definition	URL
Mentimeter	It is a tool that enables interactive question-and-answer activities in the classroom. Students can respond to questions either anonymously or with their own names. Questions can be created in various formats, such as short answer or multiple-choice. It is a suitable tool for creating the atmosphere of a quiz competition. A free version is available. Prospective teachers can be encouraged to use it in their classroom practices. With the help of this application, game-based learning materials can be provided.	https://www.mentimeter.com/
Gimkit	It is an application that gamifies exams. It allows importing data from other exam applications, such as Quizlet. A free version is available. It can be used in the process-based assessment of prospective teachers.	https://www.gimkit.com/

5. Z-Books That Can Be Used in Teacher Education

The digitization of books has transformed them into forms known as e-books and z-books. A z-book is referred to as an enriched book. With its distinct digital interface, it incorporates various multimedia features, user tools, and software (Uysal, 2024). Z-books provide an important source of material for the education of prospective teachers. They can serve both as a resource material for teacher candidates and as a medium through which they may be asked to design their own z-book materials. By bringing together different multimedia

functions, z-books appeal to multiple senses, thereby addressing the individual differences of teacher candidates as well. There is no widely accepted comprehensive example of z-books. However, the literature contains numerous tools categorized by subjects and courses.

6. Learning Management Systems That Can Be Used in Teacher Education

Learning Management Systems (LMS) refer to software that enables the management of the learning process. Through these systems, educational materials can be delivered, shared, and discussed digitally. Assignments and examinations can be managed, feedback can be provided to students, and complete records of both students and teachers can be stored within the system (Altıparmak, Kurt, & Kapıdere, 2011, p. 320). As digitalization in education increases both globally and nationally, the use of LMS has also risen in parallel (Yavuzarslan & Erol, 2022). LMSs are often confused with concepts such as internet-based learning or computer-based learning. However, while those concepts focus on a particular subject or individual learning, LMSs are management tools that encompass all of these. LMSs are expected to be flexible, user-friendly, operable across different systems, and cost-effective (Ozan, 2008). Moreover, LMSs are systems that are compatible with modern pedagogical approaches, such as constructivism, collaborative learning, motivation, and individualized learning (Duran, Önal, & Kurtuluş, 2006).

Epidemics such as COVID-19 have forced education systems around the world to shut down their face-to-face components. Such extraordinary situations have increased the importance of LMSs (Mercimek, 2022). Similarly, the earthquake centered in Kahramanmaraş on February 6, 2023, in Türkiye also led to the closure of schools for a period of time, once again bringing about an era in which LMSs were frequently used. In teacher education, there are numerous instructional tasks, including lesson plans, assignments, and discussion groups. LMSs are among the most significant assistants for managing the records of all these processes, enabling teacher candidates to work collaboratively and create product portfolios. In the literature, there are numerous studies regarding the use of LMSs in teacher education. For example, Sungur Alhan (2020) examined the experiences of science teacher candidates in a course conducted through an LMS. Similarly, Mercimek (2022) investigated teacher candidates' interactions on LMSs. Some of the LMS that can be used in teacher education are presented in Table 4.

Table 4.

Learning Management Systems That Can Be Used in Teacher Education

Tool	Definition	URL
Moodle	As a distance education system, it can be easily accessed by both teachers and students. In teacher education, various elements, such as teachers' products, assignments, and examinations, can be managed through this tool. It is open-source and free of charge.	https://moodle.org/?lang=tr
Sakai	It contains various tools, including modules for students to work collaboratively, course management panels, and grading systems. It is open-source and offers free features. It also includes additional packages developed by communities. It can operate in an integrated manner with university distance education systems. It can be easily utilized in the education of teacher candidates and can be employed in their examinations, assignments, and courses conducted through distance education.	https://online.deu.edu.tr/
OpenedX	It is also an open-source LMS, equipped with a conference module, compatible with multiple devices, and providing forums and discussion environments. With its customizable modules, it features a structure that can be adapted for both educational institutions and corporate staff training. Its use is free of charge. This LMS can contribute to teachers' professional development in teacher education through conferences, and it can enable teacher candidates to engage in discussions via forums. In this way, it holds the potential to enhance collaboration and social learning skills among teacher candidates.	https://openedx.org/

7. Mobile Learning Tools That Can Be Used in Teacher Education

In recent years, the concept of mobile learning has gained significant attention in the literature. Although mobile learning is a relatively new concept, its association is quite familiar. Mobile learning is sometimes described as learning by using a device small enough to fit in one's hand. The typical example is mobile phones. However, tablets and laptops may also fall under this scope as long as they are easily portable tools. One of the greatest advantages of mobile learning stems from the fact that mobile devices are "ubiquitous" devices (Kukulska-Hulme, 2005, pp. 1–2). Definitions of mobile learning vary depending on whether the word

"mobile" here refers to the learners themselves who use the device, or to the device as an attribute in its own right. This distinction reflects two key features of mobile learning: both the mobility of learners and the mobility of devices make them significant assistants in learning (Hockly, 2013, p. 80). However, Traxler and Crompton (2015) argued that instead of asking *"What is mobile learning?",* the question *"What is learning in a mobile age?"* better captures the essence of the issue. In short, mobile learning has become one of the important tools of education in a digitalizing and mobilizing world. One of the most significant areas where mobile learning is utilized is teacher education. Baran (2014) examined studies on teacher education related to mobile learning. The study concluded that mobile learning is supported by various pedagogical approaches. It was also emphasized that mobile learning is a crucial tool in meeting the learning needs of teacher candidates across various disciplines. Thomas and O'Bannon (2013) investigated teacher candidates' perceptions of mobile learning in the classroom. Teacher candidates generally reported that mobile learning increased participation in class, strengthened communication, enhanced motivation, and supported creativity. The literature highlights that mobile learning is a powerful tool in teacher education. However, mobile learning also has the potential to become a disadvantage for the educational process due to reasons such as prolonged screen time and distracting applications. Therefore, its use in education requires careful, planned, and controlled implementation. Some mobile learning tools suitable for teacher education are presented in Table 5.

Table 5.

Mobile Learning Tools That Can Be Used in Teacher Education

Tool	Definition	URL
WhatsApp/Telegram	These are internet-based messaging applications widely used today. Thanks to their communities and channel features, they can also provide user anonymity. Both are free of charge. Through these two applications, in-class communication can be transferred to mobile devices. Students' products	WhatsApp: https://www.whatsapp.com/?lang=tr_TR Telegram: https://web.telegram.org/

	can be shared and stored, and course-related announcements can be made. In universities, course-based groups can be used to transfer the learning process into mobile learning. They are already frequently used by teacher educators.	
Zoom/Google Meets	These applications, which can also be used on computers, are supported on phones and many other mobile devices as well. They allow multiple participants to engage in voice and video conversations and to organize meetings. They can be used with a variety of options, such as additional lessons, conferences, and serving as virtual classrooms in extreme situations where courses cannot be conducted face-to-face. These options can also be utilized in teacher education.	Zoom: https://zoom.us/tr/signin Google Meets: https://meet.google.com/
Quizlet/Kahoot	These are interactive quiz applications. Free versions are available. They are an important tool in teacher education for extending assessment and evaluation throughout the	Quizlet: https://quizlet.com/tr Kahoot: https://kahoot.it/

	process. Quizzes can be conducted in classes, and feedback can be provided to teacher candidates.	
Google Forms/ Microsoft Forms	They stand out as survey design applications. It can be said that Google Forms is more user-friendly compared to Microsoft Forms. Both applications are free of charge. In teacher education, they can be easily used to collect quick feedback from students. The collected data can also be visualized.	Google Forms: https://docs.google.com/forms Microsoft Forms: https://forms.office.com/
Khan Academy, Udemy, EdX:	These are applications that offer free or low-cost courses. Educational videos can be searched on any subject, and the ratings given by other users to the courses can be viewed. Training sets are available in a wide range of areas, including computer applications and foreign languages, to help teacher candidates develop professionally. In addition, teacher candidates who have advanced their skills in a particular subject also have the opportunity to	Khan Academy: https://tr.khanacademy.org/ Udemy: https://www.udemy.com/ EdX: https://www.edx.org/

	upload courses in the role of an instructor.	
Pixton/Canva/Powtoon:	These are applications that enable the creation of various products, such as animations, graphics, infographics, and short videos. Free versions are available. They serve as an important aid for the products that teacher candidates will produce in their courses.	Pixton: https://www.pixton.com/ Canva: https://www.canva.com/tr_tr/ Powtoon: https://www.powtoon.com/
Google Keeps/ Microsoft OneNote	These are applications that allow easy note-taking, organizing notes, and adding media to notes. Google Keep is free, while Microsoft OneNote is included in the subscription packages of many educators. They can enable teacher candidates to take notes easily both in classes and in conferences.	Google Keeps: https://keep.google.com/ Microsoft OneNote: https://onenote.cloud.microsoft/

8. Social Media That Can Be Used in Teacher Education

Social media tools have many areas of use in education. Orlanda-Ventayen and Ventayen (2017) provided examples of these practices, including making announcements, announcing exam grades, engaging in discussions, assigning homework, supporting collaborative learning, fostering peer learning, enabling student–teacher interaction, carrying out projects, and conducting individual learning activities. Greenhow, Galvin, Brandon, and Askari (2020) revealed in their research that studies on the use of social media by teachers and students have been increasing. Their study conveyed that social media can contribute to both formal and informal learning in education. Iredale et al. (2020) emphasized that the use of social

media in teacher education can enhance reflective perspectives, but that the process must be carefully planned and guided under supervision. When the research is considered as a whole, social media plays a role in teacher education that enhances collaboration, fosters reflective practices, and strengthens communication. However, due to reasons such as the protection of personal data, the difficulty of accessing useful information within the vast flow of content, the rapid circulation of misinformation, and social media addiction (Çömlekçi & Başol, 2019), caution is necessary. The social media tools that can be used in teacher education and explanations regarding how they may be utilized are as follows:

Table 6.

Social Media That Can Be Used in Teacher Education

Tool	Definition	URL
Facebook	It includes tools for creating personal profiles, forming groups, and setting up pages. By creating groups or pages, teacher candidates can share their products. In addition, through teachers' pages and groups, lesson plans, instructional materials, and similar products can be shared. It is a free tool.	Facebook: https://www.facebook.com/
Youtube	It is a video-sharing platform that provides tools such as uploading, watching, and creating playlists free of charge. In teacher education, it can be used extensively, particularly in microteaching. Uploaded videos can have a private link accessible only to a specific class. Teacher candidates can store products such as animations, short films, documentaries, and other video-based works here and share them with their peers or instructors.	Youtube: https://www.youtube.com/
X.com	Especially, experts in educational sciences share extensively on this social media platform. Teacher candidates can interact with these individuals, follow their ideas, and share those ideas. They can also keep track of important resources in their fields through the X pages of relevant organizations. By using hashtags, they can create collective ideas, follow these ideas, and gain a place in ongoing discussions. Therefore, X can serve as an important resource for the professional development of teacher candidates.	X: https://x.com/

Instagram	It is one of the most widely used social media tools today. It allows for the sharing of photos and short videos. It also has features such as creating messaging groups, forming communities, and managing pages. It provides convenience for teacher candidates to share good practice examples and their visual products.	Instagram: https://www.instagram.com/

9. Virtual Reality Applications That Can Be Used in Teacher Education

Virtual reality is a technology that, with the help of wearable display devices, enables users to interact with virtual objects and experience computer-generated simulations that closely resemble real-life experiences. Through these devices, a three-dimensional simulation environment is created (Tepe, Kaleci & Tüzün, 2016). Virtual reality can also provide significant benefits in learning environments. With virtual reality, students cannot only learn topics quickly but also gain real-life experience. Instructional processes that involve dangerous or costly applications can be carried out easily thanks to this technology (Bayraktar & Kaleli, 2007, p. 3). Virtual reality applications range across a broad spectrum, from engaging only the users' visual senses to activating all of their senses (Özer, 2023). The literature has identified many advantages of using virtual reality in education. Among these are increasing motivation, better understanding of key aspects of a subject through realism, eliminating distances, prioritizing individuality in learning, enabling interaction, and saving time (Çavaş, Huyugüzel Çavaş & Taşkın Can, 2004, p. 115). Cognitive and affective psychological studies emphasize that systems addressing multiple senses facilitate learning (Christou, 2010).

Although virtual reality applications offer opportunities, such as providing immersive and engaging learning experiences, research on their long-term effects in education remains limited. Moreover, although many studies have emphasized the significant cost-reduction potential of virtual reality applications, they are still more expensive compared to traditional educational tools such as books or other technological devices like tablets (Mazhar & Al Rifaee, 2023, p. 422). Virtual reality applications are also associated with concepts such as augmented reality, virtual worlds, and the metaverse, which can be considered parallel in terms of the degree of simulated reality. In particular, the metaverse has emerged in recent years and has become the subject of research. However, it is still too early to draw conclusions about the contributions of metaverse applications in education. The strong statements found in the literature regarding the use of virtual reality in education suggest that this technology can also be an opportunity for

training teacher candidates. Many studies have been conducted on the use of these technologies in teacher education. Yavuz and Uslu (2021) explored the views of social studies teacher candidates on the use of this technology, while Aydın and Şahin (2021) carried out a similar study with elementary teacher candidates. Çığır Dikyol and Şar İşbilen (2020) conducted an applied study related to virtual reality technology, in which social studies and elementary teacher candidates carried out a history lesson using virtual reality technology. The study concluded that virtual reality technology made significant contributions to the lesson. Similarly, an applied study was conducted by İlhan, Tokmak, and Aktaş (2021) with social studies teacher candidates. Their research indicated that virtual reality technology concretized course topics and contributed to permanent learning. Virtual reality applications for teacher education can be expanded virtually limitlessly depending on their specific area of use. Among these, virtual museum tours are a notable example.

10. Conclusion

In this chapter, instructional technologies are discussed in the context of teacher education. Teacher education should reflect the needs of the age and be structured in a way that integrates technology effectively. Technology is increasingly permeating every aspect of our lives. While it used to be less interactive, today it has reached a state of intense interaction. With elements such as social media, mobile learning, and artificial intelligence, the opportunities provided by technology have expanded. In this text, relatively new opportunities of technology have been evaluated within the framework of teacher education. For this purpose, explanations have been made under the headings of blockchain, artificial intelligence tools, mobile learning, learning analytics, social media, and learning management systems. Blockchain provides a reliable environment for storing and sharing data in teacher education systems. Artificial intelligence tools, with their creative and interactive solutions, make significant contributions to teacher candidates in the production of their work. Mobile learning, with the comfort of providing access anytime and anywhere, expands teacher education across a broad spectrum. Similarly, social media provides opportunities for interaction among teacher candidates. Learning management systems create a virtual classroom for teacher candidates and enable the process-based accumulation of their products. Learning analytics allow for close and instant monitoring of teacher candidates' learning and provide feedback at every stage of the process. Z-books, with their rich content structures, provide opportunities to appeal to the different senses of teacher candidates. They can be used both as course materials and as products through which teacher candidates can develop their professional skills. Virtual reality

offers teacher candidates the opportunity to gain real-life experiences at a low cost. All these tools can be considered collectively in terms of their various contributions to teacher education. Neglecting these contributions holds the potential to create a significant gap in teacher education. Therefore, the effective use of these tools must be ensured in the training of teacher candidates. For such effective use, the capacity of instructors in this field needs to be enhanced. Based on this text, it is recommended that the strengths and weaknesses of different instructional technologies be highlighted through applied studies.

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CHAPTER 6

The Role of Distance Education in Teacher Training

Ayşin Gaye ÜSTÜN

Chapter Highlights

- The study revealed the opportunities and challenges of teacher training in distance education.
- Technologies and pedagogical approaches used in distance education discussed within the framework of teacher training
- Academic staff qualifications required for distance teacher training are explained
- In this section, forward-looking suggestions are made for the improvement of teacher training through distance education

Introduction

The rapid growth of digital technologies has transformed not only the tools used in schools but also the ways in which teaching and learning are conceptualized. One of the most significant outcomes of this transformation is distance education, an interactive teaching model that enables students to learn from any location using digital tools. The model represents a new paradigm for teacher training, dating back to nineteenth-century correspondence courses (Afonso et al., 2022). Although the model has its roots in the nineteenth-century correspondence model, it gained significant traction in the twentieth century due to the increased popularity of radio and television programming during that time. Since the begining of the twenty-first century, online learning environments have undergone a substantial evolution, providing multi-layered, synchronous, and asynchronous learning experiences. This development has been facilitated by the rapid growth of the internet and digital platforms (Bozkurt et al., 2015). This evolutionary process has highlighted critical competencies in teacher education, including the ability to adapt digital tools, create digital pedagogical content, and the effective management of multimodal learning environments (Andriichuk et al., 2024).

The digital transformation of education worldwide experienced a significant acceleration due to the global impact of the pandemic. This shift transformed distance education from a provisional measure into a prevalent and indispensable pedagogical approach (Alsulami, 2025). In the context of the global pandemic, it became evident that a substantial proportion of students were unable to attend school in person. This highlighted the crucial role of educators in developing proficiency with technological tools (Ivanov et al., 2025). The pandemic has underscored the pressing need to overhaul existing educational systems and teacher training frameworks. Prospective teachers must acquire the skills necessary the skills to effectively utilize digital tools, manage virtual classrooms, design interactive online content, and conduct digital assessment processes (Lu, 2024). In this context, teacher training programs should prioritize preparing teacher candidates to become pedagogically competent professionals who can think critically and meaningfully integrate technology into digital learning environments, moving beyond traditional approaches that primarily emphasize the transmission of knowledge (Andriichuk et al., 2024).

In the contemporary educational landscape, educators are expected to provide effective instruction in a variety of settings, including traditional classrooms, online environments, hybrid settings, and mobile learning platforms. This multifaceted demand for competency requires teacher training programs comprehensively address distance education in terms of content (e.g., digital pedagogical knowledge, virtual classroom management, and online assessment) and methodology (e.g., synchronous and asynchronous instructional formats, digital collaboration, and e-portfolio applications) (Salavatulina, 2021). Prospective teachers require systematic support in areas such as digital ethics, online instructional design, self-directed learning, and virtual interaction to enable them to utilize digital technologies not merely as technical tools, but as instruments for creating pedagogical value (Lu, 2024). In this regard, distance education should be regarded not solely as a temporary solution during times of crisis, but as an integral and enduring component in the ongoing evolution of the teaching profession in the digital age (Ivanov et al., 2025). This section explores the role of distance education in teacher training from historical, theoretical, and practical standpoints; analyzes its relevance in light of current opportunities and structural challenges; and presents forward-looking recommendations for enhancing teacher training amid digital transformation.

1. Theoretical Foundations Constructing Distance Education in Teacher Training

Distance education that is grounded in robust theoretical frameworks, such as learning theories, adult education principles, and models of interaction, constitutes an effective and

sustainable approach to teacher training. This is because it goes beyond merely using technology. Behaviourist learning theories emphasise acquiring particular pedagogical behaviours through strategies such as repetition, reinforcement and reward-punishment. These principles inform the development of automated feedback systems, practice exercises and adaptive digital content in online learning environments (Kaplan, 2018). This theoretical orientation is particularly useful for fostering the behavioural foundations of key instructional skills including classroom management, assessment and evaluation, and basic instructional strategies. In contrast, cognitive learning theories highlight teacher candidates' internal mental processes and emphasise developing higher-order thinking skills such as understanding concepts, processing information, and solving problems. Consequently, digital learning resources for teacher trainees should be organised in a way that reduces cognitive load, incorporating multimedia components (e.g., text, visuals and audio) that have been carefully designed to promote meaningful learning (Mayer, 2009).

The constructivist approach is particularly significant in teacher training as it emphasises that learning occurs through individuals constructing meaning by integrating new information to prior experiences (Nicholson, 2010). Within this framework, teacher trainees internalise and extend their professional knowledge through active learning strategies such as discussion forums, case-based learning, project-based activities, and peer teaching in distance education environments (Murphy et al., 2005). Furthermore, because most teacher candidates are adult learners, Knowles' (1984) theory of andragogy should serve as a foundational principle in the design of distance education programs. According to this theory, adults learn more effectively when instruction is rooted in their life experiences and when content is relevant, goal oriented, and focused on problem solving. According to this perspective, flexible, personalised, and life integrated learning scenarios should be incorporated into distance teacher training (Merriam & Bierema, 2013).

The effectiveness of distance education environments depends on the quality of the content and how well they encourage interaction. Moore (1989) identified three types of interaction critical for the academic success and satisfaction of teacher candidates: student–content, student–teacher and, student–student. Providing teacher candidates with opportunities to practise teaching, receive peer feedback, and collaborate in digital environments is essential for their professional development (Nguyen & Trang, 2023). In this regard, synchronous class sessions, group discussions and digital collaboration tools (e.g., Padlet, Jamboard, and Google Workspace), which are aimed at enhancing interaction and providing real-time feedback (e.g.

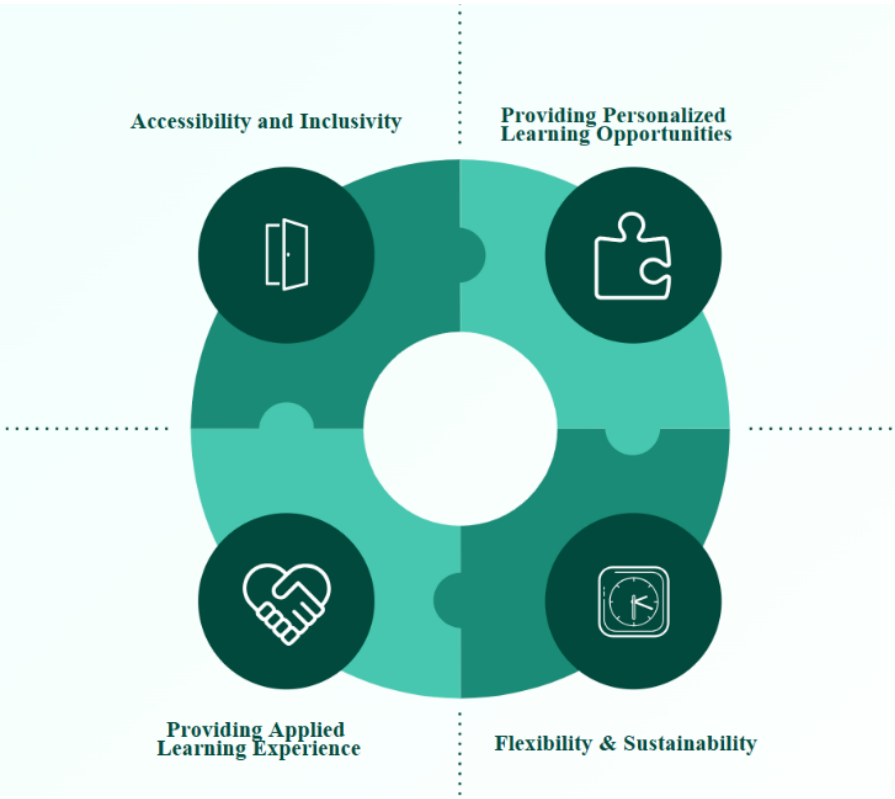
rubric-based assessment tools), reinforce the learner-centred framework of distance teacher training programmes (Sivakami & Gunasekaran, 2025).

2. Opportunities for Teacher Training in Distance Education

Distance education has become a fundamental component in reforming teacher training methodologies to address the demands of the digital era. This model plays a transformative role in shaping the profile of the modern teacher, by providing future educators with diverse learning opportunities in pedagogy, technology and instructional design (Nijakowska & Guz, 2024). The main benefits of distance education under this framework are accessibility and inclusivity, personalised learning opportunities, flexibility and sustainability, and providing applied learning experience (see Figure 1).

Figure 1.

Opportunities for Teacher Training in Distance Education



As seen in Figure 1,

Accessibility and inclusivity: One of the most significant advantages of distance education is the flexibility it affords. This flexibility enables individuals who face barriers to participating in traditional face-to-face programmes due to geographical, socio-economic, or physical constraints. Such barriers include living in rural areas, having a disability, or being a working teacher candidate, all of which make it more difficult to access teacher training programmes. In this way, distance education contributes to creating a more equitable learning environment that is aligned with the principle of equal opportunity (Hurford & Read, 2021).

Providing personalized learning opportunities: A notable benefit of distance education is its capacity to provide a personalized learning experience for each student. The integration of digital technologies, including learning management systems (LMS), learning analytics, and adaptive content delivery, facilitates the tailoring of teacher candidates' learning processes to align with their individual needs, pace, and level of prior knowledge (Ingkavara et al., 2022). Such environments have been shown to enhance digital literacy and cultivate the lifelong learning skills necessary for professional careers, thereby supporting self-directed learning (Krismanto & Tahmidaten, 2022). Furthermore, adapting instruction to individual differences has been found to increase learners' motivation and enable teacher candidates become autonomous learners who take responsibility for their own educational development (Abedi et al., 2021).

Flexibility and sustainability: The incorporation of microlearning, massive open online courses (MOOCs), and hybrid teaching models into teacher training programmes has been demonstrated to enhance flexibility and sustainability. This enhancement is achieved by facilitating access to educational resources, regardless of time and place, for candidates seeking to advance their credentials. Microlearning facilitates rapid access to knowledge through brief, focused content, thereby supporting teacher candidates in continuing their learning within demanding schedules (Adeoye et al., 2024). MOOCs expand professional development opportunities and diversify individual learning pathways by allowing teacher candidates to engage with academic content and subject matter experts from different countries (Brahimi & Sarirete, 2015). Hybrid teaching models enhance pedagogical effectiveness by integrating the technological advantages of online education with the interpersonal benefits of face-to-face interaction (Mulenga & Shilongo, 2025). Together, these models foster the balanced development of teacher candidates' digital and classroom competencies. Collectively, they also

provide personalised learning experiences while ensuring that teacher training programmes remain responsive to the evolving demands of digital pedagogy.

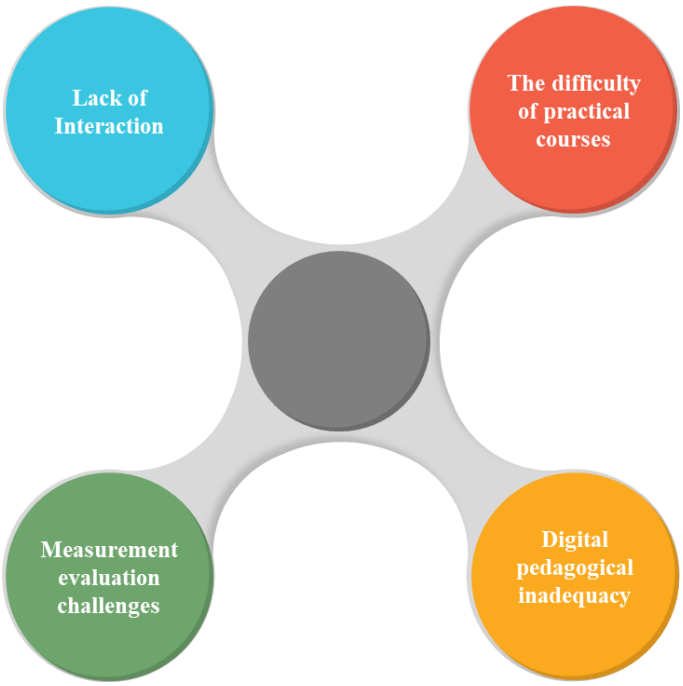
Providing applied learning experiences: Distance education offers teacher candidates opportunities for applied learning through a wide range of digital tools and platforms. Video conferencing software (e.g., Zoom, Teams), collaborative tools (e.g., Padlet, Genially, Google Workspace), interactive content platforms (e.g., Moodle, Edmodo), and online assessment systems (e.g., Kahoot, Socrative, Google Forms) enable teacher candidates to actively engage in both learner and teacher roles (Bernhardt & Szaszkó, 2024). Through these experiences, candidates can develop competencies in digital pedagogy, including technology-supported lesson design, digital content creation, and the management of online interactions (Sklyarova et al., 2023). In addition, e-portfolio systems, video-based teaching practices, and digital feedback mechanisms allow teacher candidates to document their professional development in ways that remain accessible to both themselves and their instructors (Jimarkon et al., 2021).

3. Challenges in Training Teachers for Distance Education

While distance education provides substantial opportunities in teacher training, it also presents a range of structural and pedagogical challenges that constrain the overall quality of these processes (see Figure 2).

Figure 2.

Challenges in Training Teachers for Distance Education



As seen Figure 2,

Lack of interaction: Distance education presents challenges due to the limited interaction among students in an online environments. This phenomenon can result in a deficiency of motivation. The social interaction, sense of belonging, and community that are achieved in person-to-person educational environments are greatly diminished in virtual settings. Such constraints have been shown to negatively affect teacher candidates' engagement in the learning process (Guan et al., 2024). This issue is of particularly significant in the context of teacher training, as the profession demands effective communication, sensitivity, and collaboration. As indicated by Kara et al. (2022), the absence of meaningful interaction between students and teachers, as well as among students, may hinder the development of teacher candidates' professional identities. In order to stimulate interaction and preserve motivation, teacher training programmes must incorporate more synchronous meetings, digital peer feedback, and collaborative group activities (Sason et al., 2023).

The difficulty of practical courses: The practical components of teacher training programmes, such as internships or teaching practice, pose significant challenges for distance education. Teacher candidates often rely on online training tools, which, as Ugalingan et al. (2021) noted, may constrain the development of professional competencies. While certain tools facilitate diverse degrees of participation, many prioritize passive observational learning, restrict interaction, or provide only simulated experiences (Mahajan & Vadeyar, 2022). Nevertheless, an effective teacher training process entails more than merely articulating theoretical knowledge; it must also include field-based experiences. While research acknowledges the potential benefits of online practicum processes, they cannot foster teacher candidates' practical competencies to the same extent as in-person experiences (Molina et al., 2024). To address this limitation, hybrid practicum models have been proposed, integrating online environments with authentic field experiences to support the development of professional competencies." (Oner, 2020).

Digital pedagogical inadequacy: A substantial proportion of prospective teachers possess a fundamental understanding of digital tools; however, they frequently fail to exhibit these competencies in significant ways, particularly in critical and creative contexts where they are pertinent to their pedagogical practice (Meutia & Ramadani, 2024). In practice, this has a significant impact on several critical aspects of the teaching profession, namely: the design of online lessons, the development of digital content, the management of virtual classrooms, and the leadership of students in online classroom activities (Altun, 2019). If not addressed

systematically, these issues may cause teacher candidates to become passive learners in online classrooms, thereby significantly hindering the development of their teaching skills (Fanaturiza, 2024). In this context, it is imperative to provide teacher candidates with comprehensive frameworks, notably the TPACK model. The failure to internalize TPACK competencies hinders the effective integration of digital tools into beneficial and significant teaching scenarios. Additionally, it hinders the formulation of robust pedagogical frameworks for digital education (Oktaviani & Utami, 2024).

Measurement-evaluation challenges: Within the domain of distance teacher training, measurement and evaluation processes present considerable challenges. The process of adapting process-oriented, practice-based, and performance-based assessments to online environments is challenging, and this hinders the ability to evaluate teacher candidates' professional competencies comprehensively and accurately (Agtarap et al., 2024). Monitoring individual development, delivering high-quality feedback, and establishing an assessment environment that adheres to ethical principles are complex tasks that require moving beyond traditional examination systems (Umeji, 2024). To address these challenges, the integration of alternative assessment methods such as rubric-based tools, digital portfolios, and self-assessment applications is essential. These approaches provide a more holistic representation of teacher candidates' developmental trajectories and enable educators to deliver tailored feedback (Moorhouse & Kohnke, 2022). Accordingly, the systematic incorporation of digital assessment competencies into teacher training programmes is crucial for enhancing the overall quality of distance education.

Therefore, for teacher training in distance education to be effective, it is essential that more than just technology be considered. The tools must also be configured to facilitate interactive learning and focused practice. In this context, it is imperative that teacher training programmes comprehensively facilitate the enhancement of digital competencies and application-oriented learning, while meticulously acknowledging the intrinsic constraints of distance education.

4. Distance Teacher Training in Times of Crisis

Crisis periods are defined as exceptional circumstances that evaluate the resilience, adaptability, and inclusivity of educational systems. Consequently, a comprehensive restructuring of teacher training processes is imperative. The ongoing global pandemic has had a significant impact on teacher training in Turkey, as it has in other regions worldwide. This

has precipitated a rapid transition from conventional face-to-face methods to distance and online models (Guoyan et al., 2021). During this period, teacher candidates extensively utilized learning management systems, video conferencing platforms, and digital content-sharing tools to maintain their education (Alsulami, 2025). Nonetheless, distance education assumes an even more significant role during crises, extending beyond the mere continuity of academic instruction. This includes the development of adaptable models capable of addressing diverse needs, providing psychosocial support, and addressing lost learning (Burgos & Tlili, 2020). In this context, distance education should be regarded as a strategic element of crisis preparedness and resilience within teacher training programs. In situations of crisis, such as natural disasters (e.g., earthquakes, floods, and wildfires), armed conflict, or forced migration, distance education emerges as a pivotal strategy to maintain educational continuity, mitigate spatial inequalities, and ensure that teacher candidates do not encounter impediments to skill development (Baklazhenko & Kornieva, 2023).

In order for distance teacher training to function effectively during periods of crisis, the system must be founded upon three fundamental principles: flexibility, continuity, and resilience. Given the constraints imposed by digital infrastructure, the necessity for educators to be able to move around, the emotional exhaustion that teacher candidates often experience during crises, and the uncertainty that accompanies them, it is imperative that teaching methods find a balance between synchronous and asynchronous modes, are customized to each student's learning pace, and are supported by learner-centered services (Zilka, 2021). Concurrently, the utilization of support systems, such as online peer networks, digital academic advising, psychological counseling services, and virtual learning communities, ensures that teacher candidates receive support in all areas, including emotional support, thereby fostering their resilience (Baguri et al., 2022). In this context, it is advisable for teacher training institutions to implement "pedagogical first aid" systems tailored for crisis situations. To address the needs of students experiencing difficulties, these systems must be reinforced with tools such as content repetition, diverse assessment methods (e.g., self-assessment and peer evaluation), and modular progression pathways that promote customized learning (Janapati & Vijayalakshmi, 2024).

In the aftermath of the crisis, the realm of teacher training must encompass not solely the reconstruction of physical infrastructure but also the deliberate incorporation of teacher candidates in the process of fortifying their pedagogical, social, and emotional capacities. The integration of practical courses, such as internships and teaching practicums, with tools like online simulations, video-based lesson analysis, and real-time co-observation with mentor

teachers, empowers teacher candidates to acquire sustained professional experience in digital settings (Choi & Park, 2022). It is also imperative to identify the learning gaps that individuals experienced during the crisis, create personalized learning plans to address specific areas for improvement, and implement comprehensive post-crisis learning support programs. In the context of post-crisis distance education, remedial strategies have been employed to address unmet learning objectives and to assist teacher trainees in regaining confidence, developing digital pedagogical competencies, and establishing a strong professional identity (Sadovnikova & Mirzaahmedov, 2019). Online internships and virtual environments for peer interaction have been demonstrated to exert a substantial influence on the evolution of teaching identity and the re-establishment of professional belonging among teacher candidates in the aftermath of crises.

Consequently, distance teacher training during crises should be viewed as a strategic opportunity to cultivate teacher candidates who can think adaptively and pedagogically, and who are capable of using digital tools to generate context-sensitive solutions. To realize this potential, teacher training programmes must be redesigned within crisis-responsive frameworks grounded in solid theoretical principles of crisis pedagogy and supported by robust digital infrastructures. Integrating these principles into the preparation of prospective educators ensures that candidates are equipped not only to sustain education during crises but also to innovate new teaching methods and demonstrate resilience in the face of future challenges.

5. Technologies and Pedagogical Approaches Used in Distance Education

The successful implementation of quality distance education teacher training programmes is contingent not only on the existence of adequate technology infrastructure, but also on the alignment of such programmes with sound pedagogical principles. In this instance, LMS are the primary technologies that teacher trainees use to learn in an online context (Bradley, 2021). Examples of LMS include Moodle, Google Classroom and Canvas; all of which have been shown to promote sharing of course materials, tracking assignments and activities, providing feedback, and interacting with students (Rahman et al., 2019). The utilisation of these systems enables teacher candidates to assume responsibility for their own learning, thereby facilitating a self-directed approach to education. They also encourage lifelong learning by making educational content available at any time (Shalihah & Syafryadin, 2023). LMS-based distance education positions teacher candidates not only as consumers of content, but also as digital content creators and active participants in interactive learning communities. This provides a robust foundation for developing their digital pedagogical competencies (Wirantaka et al., 2024).

The employment of synchronous and asynchronous teaching techniques in distance education has been demonstrated to enhance instructional flexibility, thereby enabling teacher candidates to adapt to diverse learning styles and life circumstances. Synchronous sessions offer opportunities for communication-oriented learning, including real-time interactions, question-and-answer sessions, and discussions. Conversely, asynchronous content empowers candidates to engage in learning independently of time and location, thereby fostering the development of self-regulation skills (Ling & Luan, 2024). Empirical studies have demonstrated that synchronous environments are particularly effective in promoting social interaction and learner engagement, whereas asynchronous settings facilitate individual reflection, critical thinking, and information processing (Siregar et al., 2023). In order to cultivate essential teaching competencies such as communication, collaboration, and empathy within online settings, synchronous and asynchronous formats should be meticulously designed in alignment with pedagogical principles (Choi & Park, 2022).

In the contemporary educational landscape, instructional design models have emerged as pivotal instruments for ensuring the efficacy of pedagogical practices. The Analyze, Design, Develop, Implement, Evaluate (ADDIE) model offers a structured, incremental methodology for instructional planning. It provides teacher candidates with a comprehensive framework that they can apply to both lesson design and the examination of the overall educational framework (Omoregie et al., 2025). The TPACK framework assists teacher trainees in comprehending the interplay between technology, pedagogy, and subject-specific knowledge, thereby enabling them to integrate these elements into their teaching in an effective manner (Oktaviani & Utami, 2024). This model has been demonstrated to enhance pedagogical efficacy by cultivating technical aptitude among educators, thereby empowering them to make more informed decisions regarding the integration of technology in their instructional practice. The Substitution, Augmentation, Modification, and Redefinition (SAMR) model assists teacher trainees in assessing the extent and depth to which they integrate digital technology into their lesson plans. In the contemporary educational landscape, characterized by the persistent digital transformation, the efficacy of models such as SAMR and TPACK in empowering prospective educators with contemporary instructional design competencies is increasingly recognized (Bond & Dirkin, 2020).

The utilization of learning analytics and feedback systems has become imperative for the effective implementation and continuous enhancement of instructional design methodologies. Digital monitoring of student participation, engagement with content, and learning performance

enables instructors to refine their teaching methods and allows teacher candidates to critically evaluate their own learning journeys (Banihashem et al., 2022). Integrating learning analytics with feedback systems has been proven to help teacher trainees learn how to regulate their own behaviour. However, automated feedback tools have specifically been shown to foster learner agency by providing students with immediate and clear instructions (Karaoglan-Yilmaz & Yilmaz, 2020). Feedback must be provided in a product-oriented, process-oriented, and interactive manner. In this context, digital technologies are imperative for the effective monitoring and modification of feedback systems (Dourado et al., 2021).

The technological systems and pedagogical models employed in distance education settings are designed to familiarize teacher trainees with digital tools and to equip them with a comprehensive set of 21st-century teaching competencies. These include instructional design, technology integration, learning analytics, and self-regulation. Consequently, it is imperative that teacher training programs integrate technology with pedagogical principles, not only to facilitate the instrumental use of digital tools, but also to foster a transformative learning experience that redefines educational practice.

5. Required Competencies in Teacher Candidates in Distance Education

In today's increasingly digital schools, it is no longer enough for teacher trainees to simply know how to use technology or possess basic technical skills. They should also be able to use these tools in a pedagogically sound, goal-oriented and critical way. One of the most important things that teacher training should do at this point is help teachers develop digital pedagogical skills. This involves using technology in meaningful, ethical and effective ways (Miguel-Revilla et al., 2020). The TPACK model was created to address this need. It provides teacher trainees with a robust theoretical framework to facilitate clear and balanced connections between technology, pedagogy, and subject-specific content (Koehler & Mishra, 2009). It allows candidates to choose the right tools and helps them judge their appropriateness for the needs of learners, content, and teaching situations (Demeshkant et al., 2022). In this context, teacher training programmes should move beyond a purely technical focus to adopt a more comprehensive, multifaceted approach that engages directly with pedagogical reasoning and decision-making.

Nevertheless, the moral and social responsibilities associated with digitalization should not be taken lightly. Teacher trainees are entrusted with the responsibility of creating and delivering content in online settings, in addition to adhering to the principles of digital citizenship. In this

context, fundamental principles such as information security, respect for copyright, ethical behavior in online communication, awareness of digital footprints, and combatting cyberbullying are interconnected with candidates' personal conduct and their professional duty to mentor students (Gondwe et al., 2023). It is imperative that teacher training programs incorporate theoretical and practical lessons on subjects such as digital ethics, rights, and responsibilities. The development of digital citizenship in future teachers will ultimately result in their ability to teach students to engage with the internet safely, responsibly and ethically (von Gillern et al., 2024). Contemporary frameworks for education increasingly define digital citizenship as a nuanced competency comprised of ethical reasoning, social responsibility, and critical awareness in the digital world, versus merely technical proficiency (Buchholz et al., 2020).

An increasingly salient issue in contemporary teacher training is the growing influence of generative artificial intelligence technologies in educational settings. Tools such as ChatGPT, Copilot, and Canva Magic Write provide teacher candidates with opportunities to design creative and efficient instructional experiences in areas such as content generation, lesson planning, assessment development, and personalized feedback delivery (van den Berg & du Plessis, 2023). However, the use of these technologies necessitates careful ethical, pedagogical, and cognitive considerations. For instance, questions related to the accuracy of AI-generated content, its pedagogical value, the degree of teacher oversight, and concerns about academic originality require teacher candidates to engage in informed critical analysis (Williams, 2024). Accordingly, it is imperative that teacher training programmes be restructured to incorporate core concepts, ethical standards, and pedagogical strategies associated with generative AI literacy (Chung & Jeong, 2024).

These interrelated components also require teacher candidates to enhance their online instructional design competencies. Effective online instruction goes beyond content delivery to include skills such as interaction design, digital classroom management, learner support services and continuous feedback mechanisms (Albrahim, 2020). To cultivate these competencies, teacher training programmes should integrate active learning methods such as project-based learning, scenario design, digital content creation and online teaching practice (Biber et al., 2023). High-quality online instructional design required not only technological proficiency but also a holistic pedagogical perspective that accounts instructional goals, learner characteristics, and the dynamics of the digital learning environment. Accordingly, it is

essential for teacher candidates to develop pedagogical, technical, and social competencies simultaneously in order to teach effectively teaching (Sokro et al., 2024).

6. Qualifications of Academic Staff for Distance Teacher Training

The sustainable, high-quality, and inclusive implementation of distance teacher training is contingent not only on the digital literacy of teacher candidates but also on the digital pedagogical transformation of academic staff tasked with designing, delivering, and evaluating these processes. In order to adapt to the opportunities and challenges of online learning environments, faculty members who base their teaching on traditional face-to-face models must change the way they teach (Mujallid, 2021). In this context, teacher training functions as a structured intervention designed to augment educators' proficiency in the effective utilization of technological tools and the formulation of pedagogical strategies that facilitate online learning (Aquino et al., 2022). In order to effectively teach online, it is essential for educators to possess not only proficient technological skills but also a comprehensive understanding of the fundamental principles underpinning digital teaching theories. At this time, the TPACK framework allows teachers to think beyond the mere technology itself. When coupled with the identification of learning objectives and content/conceptual material, the TPACK framework provides teachers with a process to plan digital content that is focused on their students' learning needs (Oktaviani & Utami, 2024). The efficacy of structured professional development programs for academic staff, grounded in the TPACK framework, has been demonstrated in improving two key aspects of higher education: the quality of instruction and the institution's responsiveness to digital transformation (Philipsen et al., 2015).

In addition, confining academic staff to the mere transmission of course content may limit student engagement and interaction in distance education environments. Therefore, the development of faculty competencies in areas such as digital content creation, learning object design, video-based instructional delivery, and the use of audiovisual materials allows teacher candidates to engage in deeper learning through multi-sensory pathways (Navarrete et al., 2025). Scenario-based learning modules, digital case analyses and interactive assessment tools are all teaching methods that can greatly improve the quality of online instruction. Furthermore, teachers' confidence in managing the online classroom context has a straightforward implication in the learning experience, affecting student participation in synchronous sessions, design and planning for differentiation and personalised support, and, in general, strategies for motivating students from a distance (Sharen & Kirk, 2023). In this context, the Community of Inquiry (CoI) framework's concepts of social, cognitive, and teaching presence mean that

academic staff must take on many roles. They must deliver content, facilitate learning, coordinate peer interaction and reflect on the educational process (Guo et al., 2022).

7. Future Perspective: The Evolution of Distance Education and Teacher Training

Distance education must not be regarded as a mere provisional measure in the context of teacher training. It is also positioned as an increasingly permanent and evolving teaching model that responds to the demands of the digital age (Arif et al., 2022). This change signifies more than a mere shift in methodology; it represents a paradigm shift in the approach to teacher training. This paradigm shift has led to the emergence of a novel teacher profile, one that is shaped by the proliferation of emerging technologies. Recent technological advancements, including artificial intelligence, augmented reality, and virtual reality, have been demonstrated to influence the learning experiences and professional skill development of teacher candidates (Thangavel et al., 2025).

Machine learning algorithms embedded in learning analytics systems can observe teacher candidates' learning processes in real time. This approach enables self-regulated learning by providing customized content and feedback tailored to each individual's learning style and level of progress (Afzaal et al., 2024). These systems provide teacher candidates with support throughout their learning journey, helping them to keep track of, manage, and evaluate their own progress. Augmented and virtual reality applications empower teacher trainees to explore diverse teaching methodologies in digital classrooms, engage with virtual students, and encounter scenarios that closely resemble real-life teaching contexts, thereby mitigating the risks associated with live practice (Wang & Li, 2024). These technologies have been shown to enhance experiential learning by facilitating the acquisition of practical skills, particularly in areas such as classroom management, student interaction, and decision-making regarding teaching methods, even when students are not physically present (Walker, 2022). Nevertheless developing technological competencies alone is insufficient to achieve effective inclusivity and ethical responsibility as part of formal teacher training systems. Educational practices must align with sustainability and equity (Demuner et al., 2024).

According to Esteron (2021), challenges related to access to digital infrastructure, shortages of devices, and disparities in internet connectivity particularly in rural regions and among socioeconomically disadvantaged populations exacerbate the risk of perpetuating the digital divide within distance teacher training. Consequently, distance teacher training models ought to be centred on digital tools and the socio-cultural contexts of learners, thereby fostering

inclusive and equitable learning environments (Pittman et al., 2021). In this regard, teacher training policies should extend beyond the integration of digital technology to encompass the promotion of access equity, the establishment of sophisticated learner support systems, and the cultivation of digital ethics (Balida 2023).

8. Conclusions and Recommendations

Distance education is increasingly recognized as a strategic learning model that promotes pedagogical flexibility, personalized learning, digital skill development, and professional growth. Rather than functioning as a temporary solution or technological substitute within teacher training, distance education is being recognized as a valuable learning model (Lie et al., 2023). The discussions presented in this section underscore the considerable advantages offered by distance education to teacher candidates, particularly with regard to expanding spatial and temporal access, fostering self-regulated learning, creating interactive digital learning environments, and supporting the development of digital pedagogical knowledge frameworks such as the TPACK model. In this regard, teacher candidates acquire the capacity to deliver effective instruction in contemporary educational settings by integrating technology with pedagogy in a meaningful manner. This, in turn, contributes directly to shaping teacher candidates as more adaptive, innovative, and technology-oriented professionals aligned with the evolving roles and expectations of the teaching profession in the era of digital transformation (Yao, 2021).

Distance teacher training programmes have been shown to have numerous advantages; however, there are also significant issues that require resolution. These include persistent digital inequalities, limited opportunities for meaningful engagement in digital spaces, a practical component that cannot fully simulate the physical environment, and issues of both reliability and validity when it comes to using online assessments (Ko et al., 2021). In order to address these concerns, instructional design practices in teacher training must transition from content-centric frameworks to learner-centred and interaction-oriented approaches, underpinned by learning analytics (Philipsen et al., 2015).

From a policymaking standpoint, there is an urgent need for structural reforms to teacher training systems to align with the evolving demands of the digital era. In order to establish an inclusive and equitable foundation for teacher training, it is crucial to update existing teacher competency frameworks to encompass digital pedagogical dimensions. Furthermore, systems must be established for guiding, monitoring, and providing feedback on remote practicum

courses. Finally, investments must be made in infrastructure, particularly in rural and underserved areas, to bridge the digital divide.

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CHAPTER 7

Measurement and Evaluation Processes in Teacher Training

Kağan BÜYÜKKARCI

Chapter Highlights

- Firstly, definitions and roles of measurement, assessment, and evaluation were introduced.
- Pre-service teachers' expected competencies in assessment and evaluation were presented.
- Assessment applications and integration of educational technologies in teacher education programs were explained in detail.
- Lastly, ethical considerations and future directions of assessment and evaluation were discussed.

Introduction

Importance and Scope of the Topic

Teacher preparation programs are the most important building blocks that directly impact the quality of education systems. The robust and adequate design of measurement and evaluation components in these programs plays a critical role in enabling prospective teachers to both develop their own pedagogical competencies and effectively monitor and guide their students' learning processes. A holistic approach to measurement and evaluation, based on knowledge, skills, and attitudes, enhances the quality of teaching processes and provides a decisive foundation for teachers' professional development.

The Role of Measurement and Evaluation in Teacher Education

Pre-service teachers' "measurement and evaluation literacy," or "assessment literacy," as it is frequently referred to in the literature, is a key determinant of educational effectiveness. A systematic literature review by Hull and Vígh (2024) revealed that workshops, assessment courses, and reflective practices are effective in developing prospective teachers' competencies in this area. Furthermore, a systematic review by Pastore (2023) emphasized that assessment competence is a sociocultural phenomenon that interacts with beliefs, identity, and cultural

context, beyond mere knowledge and skills. Therefore, teacher education must be prepared for this multidimensional structure.

Historical Perspective and Conceptual Definitions

While Stiggins's (1991, 1999) early studies on assessment literacy emphasized technical competencies such as teachers' ability to administer exams and tests and accurately interpret results, later developments (2002–2013) revealed that teachers should use assessment as a formative tool for student learning. The TALIP (Teacher Assessment Literacy in Practice) model proposed by Xu and Brown (2016) defines teachers' multidimensional competencies in their assessment processes by considering assessment competencies within a broad framework, encompassing cognitive structure, emotional attitudes, and social context components.

While standards developed in the 1990s enabled the assessment of teacher competencies in terms of assessment, these standards appear to have been reinterpreted and expanded in the context of digital assessment tools in 2024. For example, Banitalebi et al. (2024) defined specific assessment competencies for assessment environments using information technologies with the TALiDE (Teacher Assessment Literacy in Digital Environments) scale; this approach proposed an integrated assessment of both judgmental and technological roles.

Chapter Structure and Approach

This book chapter will address the theoretical foundations of measurement and evaluation in the context of teacher education programs, systematically examining both the assessment competencies of prospective teachers and how these competencies are developed in education programs. The chapter will cover the following subheadings:

- Theoretical framework: Types of assessment, concepts of reliability and validity
- Practice: Internship processes, performance assessment, portfolio studies
- Data analysis: Basic statistics, advanced analyses such as the Rasch model
- Ethics and future vision: Artificial intelligence, learning analytics, fair assessment mechanisms

This structure will provide a comprehensive analysis of the measurement and evaluation ecosystem in teacher education, addressing both scientific and practical perspectives.

1. Theoretical Framework

1.2. Teaching Competencies and Assessment and Evaluation

In teacher preparation programs, assessment and evaluation competencies directly impact the post-graduation professional performance of prospective teachers. According to a study by DeLuca and Bellara (2013), assessment competencies, a key component of teacher competency standards, require proficiency at the knowledge, skills, and professional attitude levels throughout both formative and summative assessment processes. Within the framework of competency-based approaches, prospective teachers are expected to acquire test development techniques, data analysis methods, and feedback-providing skills (DeLuca & Bellara, 2013).

1.2. Assessment Approaches Based on Learning Theories

The concept of assessment and evaluation varies based on different learning theories. While behaviorist theory emphasizes test and examination methods that stage the teaching process through measurable objectives, the constructivist approach emphasizes the importance of student-centered assessments (Black & Wiliam, 1998, 2018). Social cognitive approaches, on the other hand, state that teachers can actively intervene in learning processes through their own assessment behaviors and reflective practices (Xu & Brown, 2016). These theoretical foundations help explain why and how different assessment strategies are used.

1.3. Types of Assessment: Formative, Summative, Diagnostic

Assessment types are classified under three main headings according to their practical purposes:

1. Diagnostic assessment is used to determine students' current knowledge levels before they begin the learning process. This individualizes instructional design.

2. Formative assessment monitors progress throughout the process and provides teachers with instant feedback. Wiliam (2013) states that this approach activates students' role in the learning process.

3. Summative assessment is a general measurement, usually conducted at the end of instruction for the purpose of grading.

This tripartite framework demonstrates to pre-service teachers that assessment can be used both as a teaching tool and as a criterion (Airasian, 1994).

1.4. Characteristics of Measurement Instruments: Reliability, Validity, Objectivity, Norm-Reference

The technical dimension of teacher competence is directly related to the technical criteria of measurement instruments:

• *Reliability* means that a measurement instrument produces consistent results. Concepts such as inter-measurement agreement and test-retest validity are used (Standards for Educational and Psychological Testing, 2014).

• *Validity* is the instrument's capacity to measure appropriately for its purpose. It has sub-dimensions such as face validity and construct validity.

• *Objectivity* means that the measurement process is depersonalized and unbiased.

• *Norm-referenced measurement* is based on the principle of evaluating an individual's performance against a specific reference group.

Mastery of these criteria enables prospective teachers to conduct measurement processes both scientifically and ethically sound.

1.5. Conceptual Framework: Models and Scales

The TALiP (Teacher Assessment Literacy in Practice) model, proposed by Xu and Brown (2016), considers teacher assessment competence as a multilayered construct encompassing cognitive, emotional, and social context components. The three-dimensional model is more simply examined under the headings of conceptual (assessment knowledge), phraseological, and socio-emotional competence (Pastore & Andrade, 2019).

According to the framework defined by the NCIEA (National Center for the Improvement of Educational Assessment), data literacy encompasses pre-service teachers' ability to collect, analyze, interpret, and translate data into action. Measurement literacy requires a theoretical and practical understanding of fundamental measurement principles (validity, measurement error, etc.).

1.6 Theoretical Role of the Rasch Model

The Rasch model provides the opportunity to quantitatively analyze pre-service teachers' assessment skills. Rasch analysis can be used to analyze the reliability and calibration of instruments, particularly in rubrics and supervision processes based on performance

indicators. The use of the Many-Facet Rasch Model (MFRM) by Govindasamy et al. (2019) demonstrated that consistent assessments of supervisor classroom behavior can be achieved. Furthermore, the fundamental principles of the Rasch model emphasize high philosophical values such as "objectivity" and "invariance of measurement" in measurement.

2. Pre-Service Teachers' Assessment And Evaluation Competencies

2.1. Knowledge, Skills, And Attitude Levels

In teacher education programs, assessment and evaluation competencies are shaped around three fundamental components: *knowledge*, *skills*, and *attitude* (DeLuca & Bellara, 2013).

- **Knowledge**: This encompasses theoretical and technical elements such as measurement concepts, reliability and validity, test construction, and statistical analysis.
- **Skill**: This refers to the practical competencies of pre-service teachers, such as test writing, rubric development, and performance assessment.
- **Attitude**: This refers to an approach to ethical assessment processes, viewing assessment as a learning-supportive process, and engaging in student-centered practices.

Systematic literature reviews have revealed that these three dimensions form a complementary structure, particularly within the framework of models such as TALiP (Pastore & Andrade, 2019; Xu & Brown, 2016).

2.2. Written and Performance-Based Methods

Teacher candidates are generally taught their assessment skills through both written and performance-based assessments:

- Written exams/tests: Candidates' technical knowledge is tested using traditional question types such as multiple choice and open-ended questions. These methods are based primarily on standardized validity and reliability analyses.
- Performance-based methods: They include assessments based on real-world contexts such as portfolios, observation, video analysis, lesson plan presentation, and teaching practices. In these methods, raters—such as supervisors—assess candidates' classroom practices according to different criteria.

To ensure consistency in performance-based assessments, the Many Facet Rasch Model (MFRM) is often preferred (Govindasamy et al., 2019).

This model provides systematic accuracy in assessment by separately analyzing factors such as performance, rater attitude, and item difficulty.

2.3. Rubrics and Portfolio Assessment

Rubrics are tools that define criteria in performance measurement in a clear, leveled format. Effective rubric design includes clear leveling, explicit comparisons, and student-centered assessment. Rater reliability is increased in MFRM applications, and rubrics can be calibrated (Govindasamy et al., 2019).

Portfolios, on the other hand, are structured files in which pre-service teachers systematically collect course materials, plans, video series, reflective writing, and assessment examples. A teacher portfolio allows both decision-makers and the pre-service teacher to monitor performance in depth. It stands out as a tool that supports professional development and reflective attitudes.

2.4. Using Assessment Results for Feedback

Effective assessment involves not only collecting data but also using this data to improve teaching processes. Feedback is central to formative assessment (Wiliam, 2013). Pre-service teachers should acquire the following skills:

1. Interpreting assessment results (statistical and qualitative analysis).
2. The ability to share them with students or supervisors.
3. Designing teaching strategies based on assessment data.

For example, in UK education faculties, formative assessment processes focus not only on exam scores but also on feedback loops based on candidates' reflective writing, video analysis, and supervision reports (Bijsterbosch et al., 2019).

Summary and Evaluative Perspective

In this section, pre-service teachers' assessment competencies can be summarized as follows:

Dimension	Description
Knowledge	Measurement theory, statistics, test development
Skills	Rubric design, portfolio creation, performance assessment
Attitude	Ethics, student-centeredness, reflective approaches
Method	Written tests, portfolio, coursework
Analysis	MFRM, reliability, calibration
Feedback	Data-driven decisions, formative approach

3. Applications in Teacher Education Programs

3.1. Course and Module Design in Education Faculties

Courses and modules prepared in education faculties should aim to systematically develop teacher candidates' measurement and evaluation skills. In this process, course content should be designed in line with learning outcomes and offer practice-oriented learning opportunities in addition to theoretical foundations.

3.1.1. Theoretical framework and learning outcomes

Each module should carry clearly defined learning outcomes. These outcomes should cover teacher candidates' understanding of fundamental measurement concepts (validity, reliability, and norm-referenced systems), statistical analysis methods, and principles of measurement ethics. Black and Wiliam (2018) stated that formative assessment-focused approaches produce effective results in course planning (Black & Wiliam, 2018). Furthermore, researchers such as DeLuca and Bellara (2013) emphasize that integrating competency-based models into course content can provide a balanced development of both knowledge and practical skills.

3.1.2. Applied learning: rubrics and performance tasks

In addition to theoretical knowledge, candidates should be presented with real-world scenarios through performance-based tasks. Rubrics provide a clear and structured assessment of success in this process. For example, in Florida Atlantic University's Practicum II module, candidates:

- Are evaluated using the Narrative Observation Feedback Summary (NOS) form after at least seven observations,
- Have their professional behaviors scored using the Professional Attribute Rubric (PAR),
- Receive concrete feedback on both academic and personal development.

This structure allows candidates to demonstrate their practical skills and continuously improve the process.

3.1.3. Internship module: supervisor and collaboration

The role of the supervisor in internships is not only assessment but also mentoring, guidance, and fostering reflective dialogue. In a study conducted in Pakistan (Shahzad et al., 2019), the role of the supervisor was defined as:

- Resource person,
- Consultant,
- Moral supporter,
- Feedback interpreter,
- Evaluator.

This multifaceted approach helps candidates develop flexible and ethical approaches.

3.1.4. E-portfolios and lms integration

Technological infrastructures are increasingly being used effectively in structuring assessment and evaluation skills. By assigning pre-service teachers the task of preparing e-portfolios, they use:

- Reflective thinking,
- Process monitoring,
- Documentable development is achieved. For example, studies by Totter and Wyss (2019) indicated that e-portfolios serve as both a continuous feedback mechanism and a professional development tool.

E-portfolio systems, especially when integrated with LMS platforms (Moodle, Canvas, etc.), enable:

- Candidates to systematically record their progress,
- Teacher-supervisor-peer interactions,
- Real-time feedback loops.

3.1.5. Developing an assessment culture

Developing an "assessment culture" in education faculties is critical. This culture is based on the following principles:

1. Increasing understanding of formative assessment among faculty,

2. Perceiving the process as a learning support rather than merely grading,

3. Continuous feedback is fed into the supervisor-candidate-collaborator triangle,

4. Ensuring transparency and accessibility of assessment data through technology-enabled tools.

Lastly, reflective dialogue and self-regulated learning skills are critical in the internship process.

Outcome and Evaluation

Mx”easurement and evaluation modules in education faculties should be built on the following building blocks:

- Theoretically based learning outcomes,
- Realistic, performance-based rubrics and tasks,
- Supervisor-guided internships,
- LMS-based e-portfolios,
- A reflective and learning-centered evaluation culture.

3.2. Assessment in the Internship, Practice, and Supervision Processes

3.2.1 The relationship between the internship process and assessment

The internship is the most critical phase of the transition to teaching for prospective teachers. This period is a learning environment where theoretical knowledge is put into practice and teaching skills are developed in real-life classroom settings. It is also a testing ground where

prospective teachers' teaching competencies are concretely observed and evaluated (Darling-Hammond et al., 2017).

The assessment approaches used during the internship are largely *performance-based*: observations, video recording analysis, reflective journals, student assessment surveys, and supervisor reports are prominent in this process (Gelfuso, 2016).

3.2.2. The multiple roles of the supervisor

The supervisor is a professional who not only evaluates the prospective teacher's professional development but also grades them; they also guide, mentor, and actively contribute to the learning process. Zeichner (2010) emphasizes that effective supervision is structured in three main dimensions:

1. *Supporting reflective practices*: Providing structured feedback to help candidates review and improve their teaching.

2. *Socio-emotional support*: Ensuring that candidates, who are first in contact with the profession, develop motivation, self-confidence, and classroom management skills.

3. *Evaluation and documentation*: Documenting candidate performance as a rater and contributing to program quality assurance.

Govindasamy et al. (2019) demonstrated that using the Multi-Factor Rasch Model (MFRM) increases supervisors' evaluation reliability. This model analyzes supervisors' evaluations of candidates, revealing biases, inconsistencies, and weighting differences.

3.2.3. Measurement tools and application methods

Some measurement tools commonly used during the internship period are:

- *Observation forms*: Systematic observations are made in areas such as the teaching process, classroom management, communication, and evaluation methods.
- *Reflective journals*: Candidates conduct weekly written analyses of their course experiences.
- *E-portfolios*: Lesson plans, student work, video analyses, and reflections are collected digitally.
- *Rubrics*: These are used to increase consistency among raters in performance evaluation.

Rubric-based observation forms, in particular, allow for objective evaluation based on standardized criteria (Reddy & Andrade, 2010). The "Teaching Practice Evaluation Form," recommended by the Council of Higher Education in Turkey, is a local example of this multidimensional rubric structure.

3.2.4. Video analysis and microteaching methods

Video-based analysis methods have become widespread in modern teacher education programs. With this method, candidates record their own teaching and then conduct video analysis sessions with their supervisors and peers. This practice:

- Improves candidates' self-assessment skills,
- Enables them to recognize nonverbal classroom interactions,
- Allows them to receive objective feedback (Santagata & Yeh, 2016).

Microteaching, on the other hand, allows candidates to focus on specific skills (e.g., asking effective questions and giving feedback) through short-term teaching scenarios. It can be implemented in both face-to-face and online platforms.

3.2.5. Use of assessment data and reporting

Teaching practice evaluations not only measure individual candidate success but also provide important clues about the quality of the teacher preparation program. Therefore, evaluation data:

- Provide feedback to faculty,
- Form the basis for measuring national teacher competencies.

Data literacy has become a critical competency for supervisors and faculty members to effectively use assessment data (Mandinach & Gummer, 2016).

Summary Table: Evaluation Approaches in the Internship Process

Approach	Description
Observation Form:	Measures teaching process behaviors
Rubric:	Provides objective and standardized scoring
E-Portfolio:	Allows for process documentation and reflection
Video Analysis:	Self-assessment and collective analysis
Supervisor Evaluation:	Include both assessment and mentoring
Using MFRM:	Increases the reliability of supervisor evaluations

3.3. Integration of Educational Technologies: LMS, E-Portfolio, and Assessment Applications

3.3.1. Assessment and evaluation in the digital age

21st-century teacher education programs must include not only pedagogical content knowledge but also digital pedagogical competencies. In this context, educational technologies are opening the door to more flexible, interactive, and data-driven applications in assessment and evaluation processes (Mandinach & Gummer, 2016). *Learning Management Systems (LMS), e-portfolio tools, and data analytics-supported systems*, in particular, are bringing both individual learning processes and assessment skills of preservice teachers to the digital environment.

3.3.2. LMS-based assessment tools

Learning Management Systems (LMSs) have become central to teacher education not only by organizing learning content but also by providing assessment and feedback tools. Commonly used systems include Moodle, Canvas, Blackboard, and Google Classroom. Through these platforms:

- *Online exams and tests* can be administered with instant grading and analysis,
- *Assignment uploading and commenting* provide interactive assessment between teacher and candidate,
- *Activity reports* allow for monitoring student progress (Rienties et al., 2017).

Thanks to these systems, faculty can visualize assessment data on an individual candidate basis, and students can organize their learning with instant feedback.

3.3.3. E-portfolio: reflective and process-based assessment

An e-portfolio is a digital assessment tool that allows teacher candidates to document their teaching processes, receive feedback, and find opportunities for reflective thinking. Totter and Wyss (2019) highlighted the following benefits of e-portfolios:

- Process-based learning and development monitoring,
- Creating individual and collective feedback loops,
- Presenting academic and professional development in an evidence-based format.

E-portfolio examples typically include the following content:

- Lesson plans and teaching practices,
- Video recordings and analyses,
- Reflective journals,
- Student feedback,
- Self-assessment using rubrics and supervisor comments.

These documents make it possible to track and evaluate the development of pre-service teachers' professional competence over time.

3.3.4. Data literacy and assessment software

Educational technologies are used not only in content delivery but also in learning analytics and the analysis of assessment results. Data literacy encompasses pre-service teachers' ability to interpret statistical data obtained from these systems and guide instruction accordingly (Mandinach & Gummer, 2016).

Some commonly used assessment and analysis software include:

- SPSS, Jamovi, JASP: Used for quantitative data analysis.
- Excel + LMS reports: Suitable for monitoring student progress and achievement levels.
- Many-Facet Rasch Model (FACETS software): Analyzes the reliability of rubric and supervisor evaluation data (Govindasamy et al., 2019).

3.3.5. Distance education and asynchronous assessment applications

Distance education has become widespread in teacher education programs, especially with the COVID-19 pandemic. This transition has necessitated the digital restructuring of assessment and evaluation tools. Pre-service teachers have been directed to asynchronous exams, forum discussions, digital portfolio uploads, and online reflective journal systems (Fidalgo et al., 2020).

To increase security and ethically manage the process in remote assessment and evaluation systems, technologies such as:

- Automatic exam timers,
- Plagiarism control systems (such as Turnitin),
- Synchronous feedback mechanisms are being used.

3.3.6. A culture of ethical assessment with technology

Ethical principles have become more visible in technology-enabled assessment systems. The use of measurement data obtained through digital platforms should be structured within the following ethical principles:

- Data security and privacy: Candidate performance data should be kept confidential,
- Realistic evaluation expectations: The limitations of automated systems should be considered,
- Fair scoring: Consistent evaluation should be provided through rubrics in LMS systems (Airasian, 1994).
- These principles indicate that technological tools should be used not only functionally but also ethically.

Technology	*Application Area*	*Educational Contribution*
LMS (Moodle, Canvas)	Tests, assignments, analysis	Instant feedback, learning analytics
E-portfolio	Process monitoring, self-assessment	Reflective thinking, professional development
Rasch/FACETS	Performance assessment analysis	Reliability, objectivity
Video analysis	Micro-teaching, self-assessment	Learning awareness
Remote testing tools	Asynchronous assessment	Ease of access, flexibility

4. Ethics, Future Directıons, and Artificial Intelligence-Assisted Measurement

4.1. Ethical Principles in Measurement and Evaluation

Measurement and evaluation represent not only the technical but also the ethical dimension of teacher education. An evaluation process not based on ethical principles can prevent the fair evaluation of students and the accurate understanding of their learn ing processes (Stiggins, 2008).

Ethical evaluation practices in education are shaped around the following fundamental principles:

- *Fairness*: Equal and objective assessment practices should be ensured among students.
- *Transparency*: Evaluation criteria should be clearly stated in advance.
- *Confidentiality*: Student performance data should be protected.
- *Validity and reliability*: The instruments used should accurately and consistently reflect the concept being measured (Airasian, 1994).

The systematic implementation of these principles in higher education institutions, especially in internship and practice evaluations, ensures that teacher candidates acquire an ethical assessment culture.

4.2. Future Trends

The following trends are anticipated to gain even greater importance in assessment and evaluation processes in the future:

4.2.1. Personalized assessment

Thanks to data-driven learning analytics, assessment tools can be developed tailored to each student's learning path and pace. This approach encompasses technologies such as *adaptive testing*. Pre-service teachers should learn to develop differentiated assessment strategies for different student profiles with these systems (Van der Linden & Glas, 2000).

4.2.2. Gamified assessment (gamification)

Gamified assessment applications, a motivating and participatory assessment method, especially for new generations of pre-service teachers, will become increasingly prevalent in the future. Active participation of candidates in the learning process can be ensured through mechanisms such as points, badges, and leveling (Dichev & Dicheva, 2017).

4.2.3. Automated feedback systems

Automated scoring systems based on artificial intelligence (AI), particularly for open-ended questions, can reduce the assessment burden and provide faster feedback. However, these systems must be carefully designed to be fair, valid, and reliable (Williamson, 2019).

4.3. Artificial Intelligence-Assisted Assessment and Evaluation

Artificial intelligence (AI) is one of the most transformative forces in the field of educational technologies. AI-based systems offer new opportunities for pre-service teachers to both develop their assessment and evaluation competencies and analyze their own teaching (Luckin et al., 2016).

4.3.1. Student data analytics and prediction systems

AI can analyze student performance to predict potential success, difficulty, or risk of dropout. The use of these systems in teacher training offers a powerful model for equipping pre-service teachers with data literacy.

4.3.2. Automatic assessment with natural language processing

Thanks to AI's natural language processing (NLP) technologies, pre-service teachers' written statements (e.g., reflective journals or lesson plans) can be automatically assessed.

These systems can generate feedback by analyzing the text's semantic integrity, pedagogical structure, and cognitive level (Shermis & Burstein, 2013).

4.3.3. Ethical questions: bias, transparency, and security

The use of AI-powered systems in assessment processes also raises ethical dilemmas. For example:

- *Algorithmic bias* can create a systematic disadvantage for certain student groups.
- Due to the principle of *transparency*, pre-service teachers must be able to understand how the system evaluates.
- *Data security* is critical to preventing the misuse of student data.

Therefore, pre-service teachers should develop a critical perspective when using AI tools and not only use the technology but also be aware of their ethical responsibilities (Holstein et al., 2020).

5. Conclusion, Recommendations, And Policy Implications

5.1. Overall Evaluation

This study has revealed that the issue of measurement and evaluation in the teacher education process exhibits a multidimensional structure. When theoretical foundations, program design, applied processes, technology integration, and ethical orientations are considered together, it becomes clear that teacher candidates need to develop not only knowledge but also a *culture of measurement, practical application, and critical awareness*.

In this new era, where traditional exam-based approaches are inadequate, rubrics, e-portfolios, video analysis, and artificial intelligence-supported systems strengthen both individual learning monitoring and the effectiveness of teacher education programs (Darling-Hammond et al., 2017; Luckin et al., 2016).

5.2. Recommendations for Practitioners

5.2.1. For instructors

- Measurement and evaluation courses should be enriched not only with theoretical content but also with *practice-based scenarios*.
- The use of *e-portfolios, rubrics, and learning analytics* tools should be encouraged and integrated into the teaching process (DeLuca & Bellara, 2013).

- Supervisors should not only act as evaluators but also as *mentors and feedback providers*.

5.2.2. For prospective teachers

- They should not only familiarize themselves with assessment tools, but also develop sensitivity to *ethical principles, self-assessment skills, and data-based decision-making competencies*.
- They should develop a habit of constantly reviewing teaching processes using tools such as e-*portfolios, reflective journals, and video analysis*.

5.2.3. For faculty and program administrators

- Teacher education programs should structure assessment and evaluation modules with a *holistic approach, balancing the integration of theory, practice, and technology*.
- Supervisors should be provided with rater training using standardized assessment *forms, rubrics, and models such as MFRM* (Govindasamy et al., 2019).
- LMS infrastructure should be used effectively, and candidates' development processes should be *data-based* and tracked.

5.3. Policy Implications

5.3.1. National competencies and accreditation

- *Assessment and evaluation competencies* should be clearly integrated into the teaching competencies framework through collaboration between the Council of Higher Education (YÖK) and the Ministry of National Education (MEB).
- *E-portfolio and practice data* can be used as evaluation criteria in accreditation processes.
- Digital platforms should be proposed to *standardize the evaluations conducted within the scope of teaching practice courses on a national scale*.

5.3.2. Digitalization and artificial intelligence integration

- *Ethical oversight and transparency* should be taken into account when integrating AI-supported assessment tools into the teacher training system (Holstein et al., 2020).
- *Digital portfolio systems* that monitor teacher candidate development data should be established on a national scale.

- *Certified micro-programs* for digital assessment skills should be offered in education faculties.

5.3.3. Continuous professional development

- Assessment and evaluation is an area that requires continuous development not only in initial education but also throughout all career stages of teaching.
- In-service training programs should be designed with modules focused on data literacy, formative assessment, and technology-supported measurement.

6. Conclusion

Measurement and evaluation in teacher training processes are no longer simply a process of "measuring how much has been learned," but also of monitoring "how it was learned, how it developed, and how it was transformed." A new-generation measurement culture, structured in light of technological advances and ethical responsibilities in education, will contribute to developing future teachers as more *analytical, fairer, and more informed individuals*.

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CHAPTER 8

How to Teacher, under the Influence of Praxis Shock…

Ahmet ÖNAL

The first year of teaching is *hard, but gets better later…* (Ur, 2024)

Chapter Highlights

- **The Novice Teacher's Reality**
  The chapter reveals how new teachers struggle to reconcile idealistic expectations with the demanding realities of classroom life.
- **Praxis Shock Reconsidered**
  The chapter redefines praxis shock as a prolonged professional challenge rather than a brief adjustment phase.
- **Multifaceted Causes**
  The chapter identifies institutional, curricular, relational, and individual factors contributing to novice teachers' struggles.
- **Coping and Support Mechanisms**
  The chapter highlights mentorship, reflection, and professional learning communities as vital supports against praxis shock.
- **Rethinking Teacher Education**
  The chapter calls for stronger school partnerships, richer practicum experiences, and identity-oriented teacher preparation.

1. Novice Teachers

It would be safe to argue that the first year of practice is a tough process for any occupation; however, for the profession of teaching, it is *literally* challenging. Let us start with the definition of a novice teacher. A novice teacher can be described as "…someone who has started his/her teaching career, experiences more intensively the challenges of developing professionally, and whose expectations about teaching do not fit the school and classroom realities" (Romero, 2017, p. 16). As for the length for the novicehood, it has been observed that although there is little agreement in the relevant literature as to the number of years to be counted as an experienced and/or expert teacher (Barret et al., 2002; Cui, 2012; Jensen et al., 2012; Michel, 2013), it generally varies between one to five years. Thus, it would be justified to assert that teachers with one to five years of teaching experience can be regarded as novice

teachers (Ingersoll & Smith, 2003; Sydnor, 2017). You may ask the question: Why does it take so long? The process of becoming an effective teacher is really long and complicated because of its idiosyncratic, dynamic, ongoing, interactive, multi-dimensional and context-specific nature (Aktaş, 2018; Brown & Lee, 2015; Farrell, 2008b, 2009, 2021; Flores & Day, 2006; Hayes, 2008; Richards & Farrell, 2011; Romero, 2017; Sydnor, 2017) and novice teachers need to surmount a wide variety of personal, interpersonal, institutional and professional obstacles through this process of transition (Ur, 2024).

It is far beyond the scope of this chapter to name and address all these problems. Nevertheless, it should be kept in mind that, by its very nature, teaching involves a high degree of visibility, analogized by Blase (1988) as *working in a fishbowl*, since teachers are constantly observed by students, colleagues, principals, supervisors, mentors and parents either through their classroom performance or via concrete artefacts such as homework assignments and worksheets students take home, test reports and performance assessment surveys for parents and administrators (Kelchtermans & Ballet, 2002). In a similar vein, a teacher is visible in the hallways or the garden of the school and his/her professional qualities are constantly evaluated by other agents based on his/her ability to *keep order*. As a consequence, the novice teacher earns a kind of fame (i.e. friendly vs. hostile, strict vs. flexible, bossy vs. submissive) and that specific reputation follows the teacher throughout his/her career.

It should also be noted that the profession of teaching is notorious for its tendency to "*eat its young*" (Farrell, 2021, p. 136) and it has been viewed as one of the most stressful professions since it requires working with people with diverse needs and expectations, exerting emotional, cognitive and physical effort, assuming important responsibilities and catching up with constant changes and challenges in technology and education (Farrell, 2021; Lambeth, 2012; Turan et al., 2023). In addition, even experienced teachers suffer from several occupational tasks such as planning the lesson, managing the classroom, motivating students, enacting instructional methods, assessing learning outcomes, dealing with parents, designing and organizing classroom work and materials, timing, helping students solve their problems, relating to colleagues, and adapting to the expected norm within the school (Borg, 2008; Hayes, 2008; Romero, 2017; Stokking et al., 2003; Tekir, 2022; Veenman, 1984). If we add the obligation to deal with overcrowded classrooms under a heavy schedule and to cover a top-down mandated syllabus and prepare students for a central high-stakes examination to this list, the scenario becomes even worse for novice teachers, especially when the teachers are evaluated on the

performance of their pupils' exam scores (Akkaş & Cephe, 2022; Farrell, 2021; Urmston & Pennington, 2008).

A comparison between experienced versus novice teachers may be useful at this point. Compared to experienced and/or expert teachers, novice teachers; *(a)* stick more to the procedures, rules and guidelines rather than exercising autonomy, *(b)* are not as good at foreseeing potential problems and offering practical solutions, *(c)* spend more time planning and preparing their lessons but cannot produce longer-term plans, *(d)* tend to lack improvisational skills and exhibit a narrower repertoire of routines (Tsui, 2009). In other words, expert teachers tend to be more autonomous, are better at producing longer-term plans, help students to solve problems, and extemporize more effectively due to their larger repertoires. It should also be remembered that teaching is essentially an interpretive process in that the teacher constantly needs to monitor his/her students and the instructional context and accurately interpret the messages that come from these sources (Mpofu, 2019; Richards & Farrell, 2011). Thus, being able to read and understand the organizational context and act and/or react accordingly is an important skill for a teacher, but experience is essential for the perfection of this competence.

2. Praxis Shock

If you are reading this book (or just the chapter), you are possibly a teacher or aspiring to become a teacher. The question is, how would you (like to) describe your initial years: easy or painful? It is a very well-documented fact that the first-year is the most challenging, anxiety provoking and traumatic period for novice teachers as they experience a praxis shock despite their initial idealism and enthusiasm (Ballantyne, 2007; Ballantyne & Retell, 2020; Beauchamp & Thomas, 2009; Buchanan, 2015; Dicke et al., 2015; Farrell, 2008a, 2009, 2021; Flores & Day, 2006; Hou et al., 2023a; Kelchtermans & Ballet, 2002; Kelleci Alkan et al., 2024; Nagamine, 2012; Romero, 2017; Ruohotie-Lyhty, 2013; Şahin, 2007; Veenman, 1984; Wang, 2021; Stokking et al., 2003). However, the use of the word *shock* is, in fact, inappropriate and misleading to describe the phenomenon because it implies that it lasts for a very short duration of time (Veenman, 1984) and it has generally been reported that the intensity of praxis shock and its impact tend to decline steadily as the novice teacher gains experience; on the contrary, as has been suggested by Ballantyne and Retell (2020), praxis shock may persist far beyond the initial years throughout the profession, leading to drawbacks such as fatigue, burnout and professional dissatisfaction. In this respect, the delineation of praxis shock as well as its causes

and consequences is of utmost importance so that pre-service teacher training and novice teacher induction procedures can be reorganized accordingly.

2.1. Reasons Underlying Praxis Shock

Praxis shock can be regarded as a *natural* outcome of the clash between novice teachers' (mostly false) expectations and the realities they experience in the classroom and institution (Akkaş & Cephe, 2022; Flores & Day, 2006; Wang, 2021). More precisely, praxis shock has been viewed as a process of confrontation with the realities and complexities of a classroom, some of which test, and even challenge, the pre-set (during the pre-service teacher training) beliefs, values and ideas of the novice teacher (Kelchtermans & Ballet, 2002). It should not go without saying that the reasons for praxis shock are diverse. They may be related to external factors such as the national curriculum to be followed, national educational reform efforts, institutional culture and/or public expectations (Livingston, 2016; Wang, 2021). They may also be connected to internal factors such as wrong career choice, pre-teaching identities of the novice teachers, their educational backgrounds, beliefs and values and their interpretation of classroom events (Dikilitaş & Yaylı, 2018; Farrell, 2009; Veenman, 1984; Wang, 2021). In addition, entering the adult world with new responsibilities (such as living away from family in a completely new geographical and social district, finding a proper accommodation, and running daily chores) may also lead to and deepen the praxis shock (Farrell, 2021; Veenman, 1984). Top three reasons that challenge novice teachers are lack of support, feeling unprepared and excessive workloads; however, the list can be extended with other causes such as poor climate/physical environment, salary, too much personal investment (e.g. time/energy) and lack of a systematic and effective induction program, professional development opportunities, collegiality, mentorship, autonomy (Farrell, 2021). As an example, novice teachers are likely to experience praxis shock when the classroom management strategies they have learnt during their pre-service teacher training process fail to work in real classrooms. Moreover, incongruences as to the curriculum knowledge between the ideal and actual exacerbate the situation (Aktaş, 2018; Dicke et al., 2015; Kelleci Alkan et al., 2024; Mpofu, 2019), clearly indicating a wide gap between theory and practice.

In a similar vein, Stokking et al. (2003) maintain that praxis shock is an anticipated outcome of problems at four different domains: *institutional, curricular, relational,* and *individual*. More precisely, the lack of cooperation between teacher training institutions and schools leads to a misrepresented, or even distorted, view of what teaching is in a real school context. Likewise, the curriculum of teacher training programs is insufficient in preparing pre-service teachers for

their profession, as the proportion of practice is comparatively low and the content of the practicum is not aligned with the actual responsibilities of a teacher. In addition, mentoring and supervision processes do not contribute sufficiently and satisfactorily to the preparation of pre-service teachers because there is no effective communication between and among the pre-service teachers, mentors, and supervisors (Dicke et al., 2015; Kelleci Alkan et al., 2024; Romero, 2017; Stokking et al., 2003; Wang, 2021). Finally, at the individual level, pre-service teachers need to be encouraged to reflect-*in/on/for* their practices by sparing time to think, analyze, discuss, question, and be open to learning because during the hustle and bustle of the transition period, they may neglect the value of reflection. To further, Wang (2021) has investigated the constraints experienced by first-year English language teachers in the Chinese context and reported that institutional structures, institutional norms and external social contexts lead to the perceived praxis shock. To be more precise, having to teach for too many hours in overcrowded classes makes it harder for them to develop a good rapport with students. In addition, institutional realities such as inflexible curricula, uncaring supervisors/mentors, and unfriendly and unhelpful senior staff make the situation even worse. The district of the institution and sociocultural context, including the families of the students, may render the transition period more painful for novice teachers. As a consequence, novice teachers may feel lower professional self-efficacy and decide to forsake innovative and good practices (Hou et al., 2023b).

The manifestation of praxis shock may also be related to teacher socialization within the institution as an organization in that organizational context and working conditions may bring about certain challenges for novice teachers (Farrell, 2009, 2021; Kelchtermans & Ballet, 2002; Lambeth, 2012). This context includes the school, the level of students, the location and culture of the school, and the staff (Richards & Farrell, 2011; Romero, 2017). More precisely, one reason for praxis shock may stem from the micro-political reality of the institution that includes some important agents such as the principal, school board members, senior colleagues and parents with fixed normative ideas about effective teaching. When there is a mismatch between the ideas held by the novice teacher and these important actors, praxis shock will intensify and last much longer. In such a case, the novice teacher should develop, what Kelchtermans and Ballet (2002) label as, *micro-political literacy*, incorporating being able to *read* diverse situations, *understand* their implications from diverging perspectives and interests, and *try and learn* to handle them effectively via employing proper coping strategies. It should also be reiterated that the two factors that trigger praxis shock are high workload accompanied by

multiple responsibilities, and professional and physical isolation (Ballantyne, 2007; Buchanan, 2015; Çobanoğlu & Ayvaz-Tuncel, 2018; Kutsyuruba, 2012). High workload has been labeled as *one-man-band*, including the requirement of performing multiple roles simultaneously. Likewise, the case of isolation has been tagged as *sink or swim* approach because novice teachers generally feel that they have been left to fend for themselves and are frequently advised to *forget all they've learnt at uni,* with the implication that they need to rely on their inner resources or intuitions rather than outer support, further contributing to praxis shock.

2.2. Consequences of Praxis Shock

As a direct outcome of the conflict between the ideal and the real, novice teachers feel forced to replace their ideals with the realities of the school context, resulting in two general stages of development. In the first stage, novice teachers struggle for survival and mastery, and they focus on their teaching performance rather than their students' learning. Key issues in this stage are forming positive relationships with students, colleagues, and the institution, mastering the content to be taught, and getting better prepared for the profession (Hayes, 2008). In the second stage, novice teachers should decide either to resist change or to adapt and/or modify their practice (Farrell, 2008a, 2009, 2021; Romero, 2017). Put simply, novice teachers feel forced to surrender and acclimatize themselves to the existing culture, norms and practices. It should be noted here that novice teachers tend to concentrate more on *survival* rather than teaching better and more effectively as a result of praxis shock (Ballantyne, 2007), implying that what and how much students learn is generally disregarded.

Two more factors aggravate the situation: alternative routes to becoming a teacher and the privatization of education. As has been suggested by Bartell (2005) and Hierck and Kajitani (2024), there are alternative routes to becoming a teacher in many contexts (including Türkiye) and some teachers have dreamt about becoming a teacher from an early age, while others simply find themselves in the teachers' room. In this regard, teachers that have not graduated from a teacher training program are observed to lack knowledge about learners and learning, curriculum and teaching, and foundations of education and context. Consequently, the likelihood of praxis shock and its intensity and longevity may be more severe for this group of teachers, entailing that their induction process should be designed more attentively. In a similar line, the privatization of education encourages incompetence both at the individual and institutional levels (Palmer, 2007) because (novice) teachers feel the obligation to *keep the customers happy*, be they students or parents.

It has frequently been underlined that the potential consequences of failing to cope with praxis shock include problems in developing effective professional identity, higher stress and lower professional satisfaction, emotional fatigue and burnout, teacher attrition, higher costs and poor academic performance on the part of the students (Ballantyne & Retell, 2020; Hou et al., 2023a). Thus, immunizing novice teachers against praxis shock is crucial because the intensity and longevity of praxis shock experienced by novice teachers is a predictor of teachers' professional identity, permanence, retention, well-being, self-efficacy, burnout and future classroom practices (Ballantyne, 2007; Ballantyne & Retell, 2020; Farrell, 2008b, 2009; Kelchtermans & Ballet, 2002; Romero, 2017). This requires the cooperative efforts of all the stakeholders, including teacher training programs, teacher trainers, supervisors, mentors, school principals, senior teachers, and most importantly, policy-makers.

2.3. The Other Side of the Coin

Do all novice teachers experience praxis shock in their early years? A thorough review of the relevant literature indicates that *not* all novice teachers suffer from praxis shock in their formative years. Put differently, for some novice teachers, the transition period may be much less traumatic and negative. A closer investigation of *success stories* may be helpful to understand and identify the factors that keep novice teachers in the profession of teaching. As has been documented by Ulvik et al. (2009), novice teachers that have experienced a positive transition period adore their jobs, feel satisfied with their students and colleagues, think that they have chosen the correct career path and celebrate witnessing the progress of their students. In addition, a good match between their expectations and reality, evidence of their positive effect on the students and active participation and involvement in their own induction process ensure a positive experience (Romero, 2017). A favorable transition process may be more likely if novice teachers' personality and expectations are more or less compatible with the realities of the workplace, if they can employ effective tactics to manage their students and integrate into the social and political culture of the workplace and, if they can achieve concrete and positive influence on the students (Flores & Day, 2006). In other words, contributing to the personal and academic development of students and confirming their role through various channels (students, parents, colleagues, mentors, etc.) render novice teachers stronger in the face of praxis shock.

It has also been recommended that novice teachers need to develop and employ several *coping strategies* to immunize themselves against praxis shock and experience a smoother and more comfortable transition process. Seeking the support of friends, family and colleagues with the

help of their social skills is one of these strategies. Further, earning positive feedback from the mentor and students may develop the self-efficacy of the novice teacher and lead to a higher level of satisfaction. The novice teacher will encounter many problems during this process; therefore, s/he should be able to make use of problem-solving strategies, rebound after a challenging experience, learn from their mistakes and set achievable goals for the future and, most importantly, take good care of themselves (Tait, 2008). Taking good care of oneself is highly significant because teachers have generally been observed to ignore self-care, yet it should not be forgotten that one cannot help others if s/he is not at his/her very best physically, psychologically, emotionally, spiritually, socially and professionally (Hierck & Kajitani, 2024).

3. Teacher Identity

Does the transition from pre-service teacher to novice teacher require any changes in the (professional) identity of the teacher? Or, should novice teachers develop another (professional) identity during the process of transition? Because of its abstract and unobservable nature, the concept of teacher identity has generally been described as elusive and highly idiosyncratic; nonetheless, it is reflected in the beliefs, attitudes, values, actions and assumptions of the individual (Akkerman & Meijer, 2011; Kahveci & Bacanak, 2024; Ye & Zhao, 2018). The concept of teacher identity has been outlined as continuous and discontinuous, fixed and fluid, individual and social, and unitary and multiple (Kahveci & Bacanak, 2024), which makes it difficult to speak in certain terms; nonetheless, it can be perceived as the reflection of one's social and personal world to which they belong (Romero, 2017). In other words, a teacher reflects his/her identity in every stage of instructional procedures, from classroom management and material design to delivery of the content and assessment processes.

It has frequently been observed that novice teachers tend to hide and suppress their feelings and fail to sustain their motivation and idealism as a result of the prescribed professional and pedagogical route they are expected to follow (Canagarajah, 2012). In terms of their professional identity, novice teachers have reported the existence of a substantial gap between *what they try to feel* and *what they really feel* or their beliefs and practices (Flores & Day, 2006; Kelleci Alkan et al., 2024; Wang, 2021). In this respect, it can be argued that the transition process challenges novice teachers' former beliefs about their identities and their professional viewpoints (Akkaş & Cephe, 2022; Tekir, 2022; Wang, 2021). Further, the process of formulating *self-as-teacher* identity in relation to personal, professional and institutional domains may overwhelm novice teachers (Farrell, 2009; Richards & Farrell, 2011). In support of this, it has been revealed that in contrast to novice teachers, pre-service teachers define the

concept of teacher identity in more certain and clear terms, suggesting that praxis shock blurs novice teachers' previously fixed conceptions of what it means to be a teacher by leading them to doubt and transform their former beliefs and conceptions (Kahveci & Bacanak, 2024). Consequently, Gray (2021) opines that the modern educational context intends to transform *idealistic teachers* into *disembodied professionals* by compelling them to shape their personal and professional identities. Thus, an implication that can be drawn for teacher trainers and teacher training institutions is that pre-service teachers' identity development should be continuously monitored, and they should be better and more realistically prepared for the profession of teaching.

4. Support

In their first year, novice teachers mostly experience mixed and conflicting feelings. On the one hand, they tend to feel happy, motivated, enthusiastic, satisfied, self-confident, accomplished, passionate, excited, prideful, successful, and committed thanks to their favorable pre-service training and in-service teaching experiences as well as their ambition to make a difference (Lambeth, 2012; Romero, 2017; Şahin, 2007; Tekir, 2022). On the other hand, novice teachers may feel disappointed, uncertain, shocked, uncomfortable, anxious, vulnerable, discouraged, powerless, dispirited, failed, frustrated, sad and angry due to the gap between their ideal and actual. In the latter scenario, novice teachers need to develop several coping strategies to overcome negative feelings resulting from praxis shock (Karagöz Dilek & Balçıkanlı, 2023; Lindqvist et al., 2017; Romero; 2017). Seeking support from mentors, senior colleagues, friends and family, changing their way of thinking as a result of reflection, and observing senior teachers are examples of such coping strategies (Karagöz Dilek & Balçıkanlı, 2023). To be more precise, it would be unrealistic to expect novice teachers to master the science, art and craft of teaching in isolation; therefore, structured and well-organized support is crucial through the induction process (Farrell, 2009; Lambeth, 2012; Richards & Farrell, 2011; Romero, 2017). The support should not be limited to just the first year of teaching and it should cover early career years to help novice teachers cope with *transition traumas* more effectively and sustainably (Farrell, 2021). The support may be informal and spontaneous (offered by friends and family) or formal and organized (provided by the institution). Formal and well-organized support is vital at this phase because, unfortunately, informal and spontaneous support is inherently subjective, idiosyncratic and not readily available.

If the institution offers the formal support, it should be underscored that rather than adopting a *reactive* strategy, a *proactive* strategy may back novice teachers to navigate and handle difficult

periods more successfully and pre-empt the possible rise of praxis shock as long as novice teachers become active participants in their personal and professional development (Ballantyne & Retell, 2020; Hayes, 2008; Iwamura, 2008). It has also been observed that novice teachers wish to work in an environment where they get sufficient professional and emotional support from their colleagues (Farrell, 2021). Building good relationships with the other stakeholders in and around the school and being able to discuss didactical questions and share professional concerns with colleagues may help immunize novice teachers against praxis shock (Farrell, 2021; Kelchtermans & Ballet, 2002). It should be noted that different and even opposing *teacher cultures* may co-exist within the same school and senior colleagues may act as guardians rather than guides (Farrell, 2008b). As can be expected, if novice teachers are not guided but guarded, the induction process will become even worse for them. Assignment of a mentor who will also play the role of a sponsor and protector may solve this problem in such a scenario.

Professional learning communities (PLCs), defined as a team of teachers cooperating with the shared aim of improving their teaching performance and taking on responsibility for implementing theoretical knowledge in their classroom practice collectively, may be regarded as a viable way of supporting novice teachers' personal and professional development and pacifying praxis shock (Hou et al., 2023a; 2023b; Lambeth, 2012; Richards & Farrell, 2011). In such PLCs, teachers with varying degrees of experience can collaborate in the forms of peer coaching, team teaching, collaborative curriculum development and/or revision, presenting at professional conferences and joining professional associations (Brown & Lee, 2015). Meetings with PLCs do not have to be face-to-face because, with the latest technology, PLCs can be established on social networking sites, and such meetings can be conducted online. In this way, novice teachers have the chance to get support from other novice teachers working in different cities, or even countries.

4.1. Induction Programs

Novice teachers are usually, and unfortunately, suddenly assigned the same responsibilities and tasks as senior teachers and they are expected to perform almost as effectively as veteran colleagues, leading to substantial shock, anxiety, stress, tension and traumas (Akkaş & Cephe, 2022; Çobanoğlu & Ayvaz-Tuncel, 2018; Farrell, 2009, 2021; Hicks, 2016; Richards & Farrell, 2011; Şahin, 2007; Veenman, 1984). Thus, it is crucial for their overall (personal and professional) well-being to receive a structured and specialized induction process along with structured support (Akkaş & Cephe, 2022; Aktaş, 2018; Baran Kaya & Baki,

2023; Tekir, 2022; Veenman, 1984). This induction program may involve mentorship and support mechanisms with the aim of ending up with a smoother transition period. As has been suggested by Tekir (2022), it is not possible to speak of a universally acknowledged *best* practice in teacher induction; however, practices and policies that have proved effective and successful in one context can be adapted to new contexts by taking into account the peculiarities of the specific context. For instance, to alleviate the effects of praxis shock during the induction period, novice teachers may be assigned with lighter teaching load (Baran Kaya & Baki, 2023; Borg, 2008). Alternatively, novice teachers may be asked to observe senior teachers' classes and reflect on how they conduct their classes. Similarly, the classes of novice teachers may be observed by senior teachers and post-observation conferences may prove highly useful for novice teachers in terms of their professional development. Thus, the planning and organization of induction programs is of utmost importance since the implementation of induction programs may create problems such as trying to do too much, inadvertently encouraging competition among novice teachers and ignoring their real needs (Kutsyuruba, 2012). Put simply, the atmosphere throughout the induction program should be cooperative and collaborative rather than competitive.

4.2. Mentorship

Novice teachers can get the much-needed support from a mentor and a supervisor. The distinction between the two should be drawn at this point: mentorship aims to support the development and transformation of the mentee, whereas supervision focuses more on the maintenance of standards within the institution (Malderez, 2009). The value of the support to be offered by the mentor cannot be overstated because the mentor is expected to assume several important roles (sometimes simultaneously) in line with the requirements of the specific context and the mentee's needs. For instance, the mentor should act as a role model, supporter, coach, teacher, colleague, counselor, guide, advisor, sponsor, protector, and finally, mentor (Blase, 2009; Farrell, 2009, 2021; Hicks, 2016; Kutsyuruba, 2012; Lambeth, 2012; Malderez, 2009; Richards & Farrell, 2011). It should be highlighted that mentors should not be regarded as trainers, advisors, or assessors; though, they will certainly train, advise and assess their mentees by offering *descriptive* (rather than judgmental or evaluative) observations with the aim of identifying their needs and resolving how to proceed (Farrell, 2021; Malderez, 2009). Weekly meetings with the mentor and regular observations by the mentor may help novice teachers overcome the challenges presented by the transition phase (Borg, 2008; Brogden & Page, 2008; Ur, 2024).

On the other hand, it would be mistaken to assume that assignment of a mentor will always positively influence the induction process of a novice teacher (Farrell, 2009, 2021; Romero, 2017) since failure to strike a balance between the novice teacher and the mentor may weaken the contribution of mentorship; thus, the mentor should offer encouragement and support while respecting the novice teacher's autonomy and authority (Furness, 2008; Hicks, 2016). To overcome such inconveniences, there are some issues to take into account in the process of establishing formalized mentorship programs. First, clear guidelines for the expected knowledge, skills, and characteristics of mentors need to be ascertained. Additionally, the roles of the mentors and mentees should be clearly specified, and both parties need to be informed about their responsibilities. The selection process of the mentors is also crucial because it is frequently conducted in line with the experience and seniority of the teacher. Instead, it should be based on willingness, and mentors should be chosen from those who apply and volunteer to be mentors. Additionally, they should be trained and calibrated in line with the vision of the educational policies of the institution and the nation. Further, mentors should be assigned as mentors only, implying that if they continue their regular teaching duties, they may not have enough time to spare for the mentees. Additionally, the effort of the mentors should be appreciated and rewarded in the form of increased salary and career advancement. Finally, the fit between the mentor and the mentee should be taken into consideration in the process of matching mentors and mentees to ensure positive communication between the parties (Baran Kaya & Baki, 2023; Blase, 2009; Çobanoğlu & Ayvaz-Tuncel, 2018; Farrell, 2009, 2021; Hicks, 2016; Kutsyuruba, 2012; Malderez, 2009; Palmer, 2007; Tekir, 2022; Ur, 2024). As a final note, throughout this process, novice teachers should not act as passive receivers of the feedback but take the initiative from the very first day, establish positive and cooperative relations with the mentor and/or the supervisor (Farrell, 2021; Tekir, 2022). Put differently, the novice teacher should respect and welcome the constructive feedback offered by his/her mentor and try to adopt the suggestions in his/her classroom practices.

4.3. Supervision

Pre-service and/or novice teachers can also get professional support from their supervisors, and the role of the supervisor in the training/development of the novice teachers is crucial. The concept of supervision can be defined as "…an ongoing process of teacher education in which the supervisor observes what goes on in the teacher's classroom with an eye toward the goal of improved instruction" (Gebhard, 1990, p. 1). Though there are different models of supervision (such as administrative supervision, casual/informal supervision, clerical

supervision, cooperative supervision, and individualized/responsive supervision), Clark (1990) maintains that, as clinical supervision covers all of the developmental stages of a teacher, from pre-service through to neophyte and experienced, it is the most suitable supervision form. Likewise, rather than a *prescriptive* approach aiming at maintaining standards, a *reflective* approach that embodies specific contextual variations such as learners, their skills, purposes, values and physical settings may prove a more effective supervision process (Bailey, 2009). It should not be disregarded that each context is unique and there is no one best way of teaching; thus, novice teachers should be able to develop their unique method with respect to the peculiarities of the specific context.

The feedback offered by the supervisor is vital for the personal and professional development of the pre-service teacher (Farrell, 2021). However, the stage of delivering feedback to the novice teacher may be regarded as a face-threatening situation, especially if the supervisor has to transmit bad news, and the supervisor may need to make use of mitigation strategies during this stage; thus, the training process of supervisors should also cover such strategies to be employed during post-observation conferences (Bailey, 2009). Moreover, supervisors need to conduct their assessment in a formative rather than summative manner to ensure the professional growth of novice teachers, and the burden should be shared with novice teachers by including their voices and opinions in a collaborative fashion (Farrell, 2021). To achieve this, both parties need to employ effective communication skills and use common terminology to prevent misunderstandings.

4.4. Practice Teaching

Teacher training programs have mostly been criticized on the grounds that they do not offer sufficient practice opportunities to pre-service teachers, and consequently, pre-service teachers experience great difficulties in practicalizing what they have learned during the theoretical classes (Coskun & Daloglu, 2010; Öztürk & Aydın, 2019). In this respect, microteaching and practicum are two kinds of practice teaching opportunities for pre-service teachers (Richards & Farrell, 2011). It is not possible to speak of a standard integration and implementation of microteaching and practicum in view of the fact that each teacher training program arranges the frequency and intensity of practice teaching in line with their local and national regulations and requirements. Nevertheless, it would be justified to argue that the more practice opportunities pre-service teachers are given, the less likely they are to suffer from praxis shock, as such experiences provide them with a clearer picture of what awaits them in their future profession.

4.4.1. Microteaching

In the context of a conventional microteaching session, pre-service teachers are required to design a lesson plan on a predetermined topic and deliver the lesson in the presence of their peers and supervising instructor. This process is subsequently followed by an evaluative phase, during which the pre-service teacher may be expected to revise the lesson plan in accordance with the feedback provided and to deliver the revised lesson once more. Thus, the basic stages of microteaching involve: *briefing, planning, teaching, critique,* and *reteach* (Wallace, 1991).

Microteachings are, by their nature, short in duration; therefore, they are comparatively less stressful on the part of the pre-service teachers and pre-service teachers can try out innovative ideas in a safe environment. They also have the chance to *try again* in line with the feedback they receive from their supervising instructors and peers (Richards & Farrell, 2011). On the other hand, trying to teach in a limited time and artificial context appear as the main drawbacks of the microteaching technique. To make the best use of the microteaching technique, the supervisor should encourage pre-service teachers to reflect-in/on/for-action by giving reflective and descriptive rather than prescriptive feedback (Richards & Farrell, 2011) so that pre-service teachers learn from their (and their peers') mistakes and perform better in a progressive manner.

4.4.2. Practicum

Also named as practice teaching, apprenticeship, clinical experience, school-based experience, practical experience, field experience and internship, practicum offers pre-service teachers supervised teaching, becoming familiar with a particular instructional context and practice accompanied by systematic observation and constructive feedback (Gebhard, 2009; Richards & Farrell, 2011; Yazan, 2015). It has been repeatedly asserted that practicum should be an integral component of teacher training programs, and its systematic integration into the teacher training process is crucial for familiarizing pre-service teachers with the realities of an authentic classroom (Farrell, 2021; Legutke & Ditfurth, 2009; Richards & Farrell, 2011; Yazan, 2015). In this way, the expectations of pre-service teachers become more aligned with the realities of a classroom.

Additionally, practicum enables pre-service teachers to develop their discourse skills, to construct their professional identity as a teacher, to apply theoretical and professional knowledge in real classroom contexts, to understand the significance of the context, and to learn to theorize from practice (Farrell, 2021; Richards & Farrell, 2011). To recapitulate, practicum assists pre-service teachers in bridging the gap between theory and practice as well as

positioning their personal and professional identities in line with the context in which they operate. Other professional benefits of a well-designed practicum on the part of the pre-service teachers have been summarized as; *a)* learning how to navigate in a real school context by familiarizing themselves with the inner working mechanism and dynamics of the institution, *b)* learning how to establish and maintain professional and personal relationships with their mentors and students, *c)* learning and improving mediating tools (such as lesson plans, classroom management strategies, etc.) with the support of their supervisors and mentors, *d)* understanding and constructing the relationship between the theoretical and practical aspects of teaching, *e)* gaining a better understanding of their students by forming good rapport with them (Yazan, 2015, pp. 181-189).

During the process of practicum, two main agents of support for the pre-service teachers are their mentor teachers and university-based supervisors. Assuming that supervisors have a say in selecting and allocating schools and mentors, the process needs to be conducted with great attention since it can lead to a distorted view of the profession of teaching (Richards & Farrell, 2011; Stokking et al., 2003; Şahin, 2007). In addition, it is important for pre-service teachers to gain experience in teaching in a variety of contexts; thus, practicum should be implemented in any kind of school and cover diverse age groups (Borman et al., 2009; Farrell, 2021; Richards & Farrell, 2011; Şahin, 2007). As a result, pre-service teachers get the opportunity to become more informed about students coming from a diversity of social, cultural and economic backgrounds, which may enable them to be better prepared for their future professional lives.

4.5. Reflection

Reflective practice can be described as implementing an intentional inquiry into an individual's thoughts and actions as a response to a perceived problem (Goodell, 2006) and it refers to the skill of synthesizing, integrating and applying knowledge that leaks out from multiple sources (Hollins, 2011). As has been aforementioned, pre-service and novice teachers will possibly get feedback from a variety of stakeholders, including their students, supervisors, mentors and even parents. In such a situation, they are to choose between two options: either *be reflective* or *get defensive* (Hierck & Kajitani, 2024). Reflecting on daily classroom experiences and talking with a mentor or colleague may render the transition process less painful and more comfortable for the novice teacher because s/he gets the chance to learn from others' experiences (Ur, 2024). Sharing personal and/or professional problems with colleagues may be somewhat difficult due to inhibition, sense of shame, or fear of losing face; however, a welcoming and positive working atmosphere may be helpful. The mentor and the school

administrators are responsible for building such an atmosphere within the school (Tekir, 2022). In such a setting, novice teachers are expected to become *adaptive professionals* by constantly reflecting on, evaluating and adapting their own practice (Farrell, 2021; Richards & Farrell, 2011).

5. Suggestions for Teacher Training Programs

Teacher training programs differ greatly from each other across the world in terms of their design, structure and practices; however, the common point for almost all of them is the fact that novice teachers seem to struggle throughout the transition process from pre-service teachers to in-service teachers (Ballantyne, 2007; Borg, 2008; Dicke et al., 2015; Farrell, 2008a, 2009; Flores & Day, 2006; Hayes, 2008; Hicks, 2016; Iwamura, 2008; Klusmann, et al., 2012; Romero, 2017; Stokking et al., 2003). Put differently, novice teachers suffer from praxis shock during the transition process, and unfortunately, the intensity of praxis shock may be so high and distressing that novice teachers may start blaming their teacher training program for their (perceived) failure and question their decision to be a teacher (Şahin, 2007). The aim of this section is, therefore, to present several recommendations to teacher training programs so that they can better equip pre-service teachers for the potential difficulties they are likely to encounter in their initial years.

It should be noted that praxis shock has alternatively been named as *reality shock*, which implies that teacher training programs, first and foremost, need to help pre-service teachers develop a much more realistic view of the realities of the profession of teaching (Ballantyne, 2007). Otherwise, novice teachers may discard what they have learned at university (i.e. *forget all you've learnt at uni*) and adopt the institutional culture without any kind of questioning. What is meant by these realities refers to what kind of challenges novice teachers may encounter and how these challenges can be addressed throughout the teacher training program. In other words, teacher training programs need to be designed in such a way that pre-service teachers become better equipped to proceed efficiently in their initial years in the profession and the likelihood of praxis shock becomes minimized (Ballantyne & Retell, 2020; Farrell, 2021; Veenman, 1984). To do this, first of all, teacher trainers themselves must be knowledgeable about the social and cultural context of the schools (Farrell, 2008a). For instance, in most contexts (including Türkiye), pre-service teachers are trained at universities located in big cities or city centers, where they can eat at global fast-food chains, drink, let's say, a cold brew latte, then watch the latest released film at a 3D cinema and waste time at a shopping center. The bad news is that they are mostly assigned to rural areas, where they cannot enjoy such luxuries. As a

result, they try to move back to urban areas, where they can re-enjoy such facilities. Otherwise, the reality shock intensifies. Thus, pre-service teachers need to experience living and teaching in rural areas and learn about the students' social, cultural, economic, emotional, cognitive realities as well as regional differences throughout their training so that they can be better prepared for their induction process (Ceylan et al., 2017; Farrell, 2009; Romero, 2017; Tavil & Güngör, 2017). What is meant here is that we should try to prepare and train pre-service teachers for contexts they are expected (or obliged) to work in by familiarizing them with the conditions of such contexts during teacher training.

In line with this, pre-service teachers complete their practicum mostly in schools that are located in urban areas and they deal with the problems experienced by students that live in flats. However, the daily tasks or tensions of the students living in a rural area are completely different from those of their counterparts in an urban area. The problems encountered by the students are important because they may lead to crises during the class and require teacher intervention. In this regard, pre-service teachers should be confronted with tensions they (or their students) are likely to encounter during their transition throughout their teacher training process in a controlled and balanced manner (Sydnor, 2017). It has also been suggested that teacher training programs intentionally encourage pre-service teachers to reflect on critical incidents they experience during their practicum to facilitate their induction period (Arlinda et al., 2024). The intensity of the tension needs to be adjusted correctly and in a balanced fashion so that pre-service teachers neither underestimate nor feel daunted by the tension.

In a similar fashion, Urmston and Pennington (2008) maintain that the theoretical instruction of methods and techniques included in teacher training programs cannot match what pre-service teachers can learn from experience in real teaching contexts. It has been observed that teacher training programs do not provide pre-service teachers with enough opportunity to practice in a real classroom atmosphere; thus, in order to alleviate the intensity and longevity of praxis shock, teacher training programs need to offer more practical experience for the pre-service teachers (Farrell, 2021; Kelleci Alkan et al., 2024; Romero, 2017; Şahin, 2007). It needs to be reminded that it would be highly unlikely for teacher training programs to anticipate and simulate all the possible tricky situations and events novice teachers may face during transition (Veenman, 1984); nevertheless, a closer communication and cooperation between teacher training programs and schools may help teacher training programs to become better informed about various challenges and influences that novice teachers may face during the transition into the profession (Farrell, 2009). As has been highlighted above, there should be closer collaboration

between and among all the stakeholders to enable novice teachers to practicalize theory more effectively and to relieve the incidence of praxis shock.

As a consequence of such closer cooperation, teacher training programs may encourage pre-service teachers to be adaptive professionals with clear visions, enable them to acquire plenty of practical experience by creating zones of contact with schools, and organize field placements by critically investigating what they offer (Sydnor, 2017). In addition, the importance of reflection should also be underscored since, as has been advocated by Mpofu (2019), rather than teaching how to act, we should guide pre-service teachers to reflect on their practices. Furthermore, the process of gaining the skill of reading the situation and acting appropriately (i.e. *micro-political literacy*) should start during pre-service teacher training (Kelchtermans & Ballet, 2002) so that novice teachers become more prepared for the constraints they are to encounter in their initial years. In support of this, pre-service teachers should be equipped with the essential knowledge base for analyzing possible problematic situations and employ strategies to find solutions and compensate for their limited experience base (Iwamura, 2008). This can be conducted by integrating case studies into theoretical classes.

Finally, pre-service teachers should be instilled with the notion that the art and craft of teaching is an ongoing and lifelong process that requires practicalizing theoretical insights in line with the peculiarities of the specific context, which cannot be achieved in one academic year (Brown & Lee, 2015; Farrell, 2021; Mpofu, 2019). If this understanding can be developed, novice teachers may overcome the process of praxis shock with less effort and in a shorter period. It has also been suggested that specific courses (Teaching in the First Year, From Novice to Master, Critical Classroom Incidents, etc.) that address the challenges of teaching in the first few years should be incorporated into the curriculum of teacher training programs (Farrell, 2009, 2021). However, it should be noted that teacher training institutions may not have the flexibility to modify their structure and course content if they are required to adhere to top-down mandated national standards (Farrell, 2021). In this case, teacher training programs may cover related topics such as how to practicalize theory, how to manage critical classroom incidents and the challenges of teaching in the initial years under other relevant courses.

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CHAPTER 9

Establishment of Teacher Academy

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Chapter Highlights

- The evolution of teacher education in Türkiye demonstrates a century-long transition from Darülmuallimîn to the National Education Academy, symbolizing a continuous quest for a qualified and practice-oriented teaching profession.
- Despite numerous reforms, Türkiye's teacher training system still faces persistent challenges including policy instability, theory–practice discrepancies, and declining professional motivation.
- Comparative insights from Finland, Singapore, and Germany reveal that selective admission, structured mentoring, and practice-based education are decisive components in cultivating high-quality teachers.
- The establishment of the National Education Academy represents a paradigm shift in teacher development, integrating evidence-based pedagogy, digital competencies, and systematic mentoring into a national framework.
- Building a sustainable teacher education model for Türkiye requires policy continuity, strengthened international collaboration, and institutionalized lifelong professional development aligned with global standards.

Introduction

The fundamental objective of education systems is to nurture the human resources of a nation. The overarching objective of education systems worldwide is to foster economic development and prosperity, enhance global competitiveness, and preserve and transmit cultural heritage to future generations (Hirsch, 2008). To achieve this objective, it is incumbent upon nations to ensure that future generations are equipped with the latest knowledge and skills, to embrace the cultural values of their society, and to respect different cultures. Educational institutions and the teaching faculty are the primary responsibility for raising these generations. In addition to equipping teachers with cognitive skills, they are responsible for the provision of advice, evaluation, discipline, and the promotion of social morality. A substantial corpus of

academic studies has indicated that teachers are the most influential factor in educational outcomes (Archibald, Coggshall, Croft, & Goe, 2011; Darling-Hammond, 2000). In this context, the words of Atatürk, the founder of the Republic of Türkiye, that "Teachers, the new generation will be your masterpiece," take on a particular significance. Andreas, Director of the Programme for International Student Assessment (PISA), a programme organised by the Organisation for Economic Co-operation and Development (OECD), claimed, "An education system can only be as good as its teachers" (Altuntaş, 2017). Nevertheless, despite its pivotal function in shaping the future and society, the teaching profession has encountered various challenges and contradictory policies in Türkiye. The implementation of due diligence in the teaching profession has been postponed for several reasons. It is frequently asserted that contemporary educational practices are not yet commensurate with the societal and pedagogical expectations that have been established (Neyişçi, Turabik, Gün, & Kısa, 2020).

Advancements in science and technology, coupled with shifts in societal structures, have precipitated novel paradigms for educational paradigms on an international level, encompassing social, cultural, and economic dimensions. These new roles have served to underscore the significance of education, thereby placing it at the center of various social issues. In this context, the search for better ways to achieve quality education has become even more important. This section commences with a concise historical account of the Turkish teacher training system. The second section of this study discusses the status and challenges of Türkiye's teacher training programme. The third section of this publication sets out to describe global teacher training practices. The fourth section delineates the fundamental components of the teacher training process. The fifth and final section of this study addresses teacher academies and their expectations.

1. The Historical Process of Teacher Training in Türkiye

The teacher training system in Türkiye has historically been subject to constant change in policy, a centralized structure, and various problems encountered in practice. Indeed, the Ottoman period was the first to witness the establishment of modern teacher training schools. The first step in the direction of modern teacher training in the Ottoman Empire was taken with the opening of the Darülmuallimîn-i Rüşdî on 16 March 1848. The institution was founded with the express purpose of training teachers for secondary schools, thus contributing to the professionalisation of the teaching profession. Subsequent years witnessed the implementation of the 1869 General Education Regulation, which precipitated a gradual restructuring of the education system. Concurrently, institutions such as the Darülmuallimîn-i Sıbyan and the

Darülmuallimât came into being. The Darülmuallimât, which was established in 1870 and is noteworthy as the inaugural institutional framework for the training of female pedagogues, represents a seminal development in the field of education. The establishment of teacher and muallime schools marks the beginning of a period during which a wide variety of models have been experimented with. This has continued for the past 150 years. Examples of such institutions include village institutes, village teacher training schools, secondary teacher training schools, training institutes, two- and three-year educational institutes, and higher teacher training schools.

The Republican era teacher training process is recognised for its institutionalisation and reforms. Following the establishment of the Republic, there was a restructuring of teacher training policies in accordance with national educational objectives. From 1923 onwards, the training of secondary school teachers was systematically organised. During this period, secondary teacher training schools, and especially the Gazi Education Institute (Figure 1), were at the centre of teacher training (Becerikli, 2020).

Figure 1.

Ankara Gazi Secondary Teacher Training School

Following the establishment of the Republic, a series of changes were implemented within the educational sector, encompassing both the structure of schools and the curriculum. The Ankara Gazi Secondary Teacher Training School commenced operations in the 1928-1929 academic year, with a specialization in training mathematics teachers for secondary schools. In 1932, the Primary Teacher Training School for Boys was abolished, and the institution was renamed the Gazi Secondary Teacher Training School and Education Institute. In its stead, the Gazi High School, a fee-based boarding establishment offering instruction in English, was established. During the 1936-1937 academic year, Gazi High School relocated to a separate building, and English instruction was discontinued.

During the 1946-1947 academic year, the Turkish, History-Geography, Mathematics, and Physical and Natural Sciences Departments were consolidated under the designation "Collective Courses Department," a measure that was implemented with the objective of optimising service provision whilst minimising the number of teaching staff. During the 1948-1949 academic year, the department was divided into two sections: As Akyüz (2007, p. 387) argue, the fields of "science" and "literature" are inextricably linked. Concurrently, the Village Institutes, a distinctive initiative of the Republic, were established by Law No. 3803 dated April 17, 1940. The Village Institutes not only provided training for teachers but also supported rural development and offered an educational model integrated with production. These institutions, which were closed in 1947, are regarded as one of the most distinctive examples of a practical and community-based teacher training approach (EERA, 2016). The second phase of the 1960s witnessed the erection of new edifices, the augmentation of the teaching faculty, and a rapid escalation in departmental differentiation, owing to the aspiration to address the nation's pressing demand for educators. The establishment of three new departments, namely Mathematics, Social Studies, and Art Education, has led to an augmentation in the number of departments. Concurrently, the nomenclature of the Science and Literature Departments was modified to "Science and Natural Sciences" and "Turkish" (Sakaoğlu, 1992). As demonstrated in Figure 1, English was included in the newly opened departments in the 1967-1968 academic year, German in the 1968-1969 academic year, and Music in the 1973-1974 academic year. The second article of the Regulation on Educational Institutes was amended in the 1967-1968 academic year, extending the duration of instruction at institutes to three years (Regulation on Educational Institutes, 1967). In order to address the teacher demand, a range of measures were implemented. These included the delivery of training programmes, both accelerated and correspondence, the deployment of military personnel as teachers, and the appointment of high school graduates to educational institutions.

In 1982, a significant restructuring within the educational sector occurred, marked by the transformation of educational institutes into education faculties. The Council of Higher Education (YÖK) law, in its capacity as the governing body of universities, instigated a transformation of education institutes into four-year faculties, thereby introducing a standardised, albeit relative, approach to this distinction. In 1982, the responsibility for teacher training was transferred to universities, and education institutes were transformed into faculties (Kavak, 1989). The Department of Primary Education, which was initiated as a pilot programme in Türkiye and commenced operations in numerous settlements by the late 1980s,

was formally established in the 1992-1993 academic year with the primary objective of training primary school teachers for 6th, 7th, and 8th grades. The existing classroom teaching department was converted into a department of classroom teaching. The departments of science teaching (1992-1993), mathematics teaching (1998-1999), preschool teaching (1998-1999), and social studies teaching (1998-1999) were established within the same department, respectively (Şahin, 2011, p. 1130). In the 1998-1999 academic year, the Council of Higher Education (YÖK) implemented a restructuring of primary school teaching at the undergraduate level, while secondary school teaching was established at the graduate level (Kavak, 1989). In the 2000s, the basis of teacher employment shifted to the results of the Public Personnel Selection Examination (KPSS). During this period, teachers were employed on permanent staff, contracts, or substitute positions (Kavak, 1989).

Whilst the affiliation of education faculties to the Council of Higher Education constituted a significant structural change in the field of teacher training, it did not entirely end the debate. It is important to note that several criticisms were voiced, particularly with regard to the quality of teacher training, the scope of programmes, and institutional functionality. As asserted by Yıldırım and Çobanoğlu (2025), certain reforms in the domain of teacher training in Türkiye were executed without the requisite comprehensive evaluation, engendering uncertainty with respect to the direction and content of the programs. In addition, the literature (Yıldırım & Çobanoğlu, 2025) highlights the role of education faculties in teacher training and the problems associated with resource utilisation. This state of affairs has given rise to a debate about the optimal manner in which pedagogical formation should be conducted in science and literature faculties, which serve as a resource for field course teachers, as opposed to in education faculties. According to a report published in 2007 by the Council of Higher Education (YÖK), three significant developments occurred between 1982 and 2007 (YÖK, 2007). In 1989, the duration of the primary school teacher training programme was extended from two to four years. Consequently, the departments responsible for classroom teaching were unable to graduate students for several years. The resulting teacher shortage was addressed by graduates of various faculties participating in a 26-week pedagogical formation course. The second development was the introduction of new regulations for education faculties, initiated by YÖK in collaboration with the Ministry of National Education in 1996 and implemented in 1997. The regulation in question assigned teacher training exclusively to education faculties. This situation may have been triggered by a desire to train progressive and contemporary teachers

rather than a concern for higher-quality teachers. The final change during this period, in 2006, focused on practical aspects of pedagogical formation courses.

Subsequent changes were implemented after 2007. The pedagogical formation programme was transformed into a master's programme, albeit a non-thesis one, as is customary in Western Europe. Completion of the three-semester programme was deemed to render students eligible for teacher appointment. Subsequently, non-thesis master's programmes were discontinued, and pedagogical formation was reconfigured as a certificate programme. The programme was initially made available to any interested parties. Subsequently, a few years later, it was offered to senior students from faculties other than education faculties. This practice, which was maintained for a period of several years, was subsequently offered as an elective course during the final two years of university studies. This pedagogical innovation rapidly gained traction, with virtually all universities incorporating these courses into their curriculum. Consequently, these circumstances gave rise to an additional issue. With regard to the present state of education faculties, the report states the following: "There are significant differences among education faculties in terms of faculty qualifications, physical facilities, and practical opportunities" (YÖK, 2007, p. 45). This situation demonstrates the absence of shared standards to guarantee the quality of teacher training, thus underscoring the necessity for an accreditation system. However, in an era where pedagogical formation courses offered by universities have become devoid of value and are merely perfunctory due to their absence of accreditation, the endeavours of the National Education Academy, the central institution for teacher training, to assume control over these courses have not encountered any scientific opposition. The present circumstances offer favourable justifications for the National Education Academy.

2. Türkiye's Current Situation and Problems in Teacher Training

In Türkiye, the primary institution responsible for the training of teachers is the university faculty of education, with the content of such training programmes determined by the Council of Higher Education (YÖK) (Barış & Hasan, 2019). The selection of teacher candidates is typically conducted through a centralised examination system, and the candidates are subsequently placed into training programmes that are grounded in theoretical knowledge (Aykaç & Şahin, 2018). However, frequent changes are made in teacher training programmes, leading to stability problems (Barış & Hasan, 2019; Aykaç & Şahin, 2018). The duration of the internship and the collaboration between schools and universities are inadequate, resulting in challenges for teacher candidates in developing their professional competencies (Gürbüz, Aydın, & Gürbüz, 2022). The duration of the practice phase has been identified as a particular

area for improvement in terms of mentoring support and the quality of practice (Baş & Nural, 2023; Başaran Uysal & Savaş, 2021; Uzeirli, 2018). This situation has the effect of limiting the intended impact of effectively translating theoretical knowledge into practice. For instance, teaching practice courses are ordinarily available in the final year. However, a significant proportion of final-year students are preparing for exams to be appointed as teachers. It is evident that the necessity to address their paucity of experience is incumbent upon them, and this is achieved through their own personal endeavours following their appointment. From a broader perspective, the fundamental problems in the literature on teacher training in Türkiye can be categorized under six headings:

1. Policy and Program Instability: Constantly changing teacher training policies negatively impact the timeliness and effectiveness of programs (Barış & Hasan, 2019).

2. Theory-Practice Discrepancy: The majority of programs are grounded in theoretical knowledge, with a conspicuous absence of practical and professional experience (Uzeirli & Kılıçoğlu, 2021).

3. Quality and Quantity Issues: The professional and personal competencies of prospective teachers, the content of the programme, and the quality of faculty are matters of debate (Işik & Sezgin, 2020; Nigar & Basri, 2022).

4. Issues Relating to Employment and Appointment: The employment of graduates is problematic due to the presence of a centralized examination system and an imbalance in the distribution of quotas (Barış & Hasan, 2019; Aykaç & Şahin, 2018).

5. Professional Development and Status: As demonstrated in the relevant literature, the social status and salary level of the teaching profession have been shown to have a negative impact on the level of interest in the profession (Aykaç & Şahin, 2018).

6. The issue of diminished teacher motivation is a salient concern. There is a pervasive societal perception that the prestige of the teaching profession is in decline (Şimşek, 2019). This perception has been shown to have a detrimental effect on professional motivation and commitment to the teaching profession.

The proposed solutions to these fundamental problems are summarised in Table 1, with reference to the relevant academic literature.

Table 1.

Fundamental Problems and Solutions to the Teacher Training System in Türkiye

Basic Problem	Solution Proposal	Reference
Policy and program instability	Long-term, scientifically based planning	Fullan (2001), OECD (2019), Yıldırım (2013)
Theory-practice gap	Increasing the duration of practice and internships	Darling-Hammond (2017), Shulman (1986), Demirel (2015)
Quality/quantity issues	Improving program and faculty quality	Cochran-Smith & Zeichner (2005), OECD (2019), Bayrakçı (2018)
Employment and appointment issues	Multiple evaluations and fair quota distribution	Ingersoll (2001), Day (2008), Ersoy (2017)
Professional development status	Improving salary and benefits	OECD (2019), Ingersoll (2001), Çelik (2016)
Low teacher motivation	Career development opportunities, mentoring, and support programs	Ingersoll (2001), OECD (2019), Şimşek (2019)

To establish a sustainable and high-quality teacher training system in Türkiye, it is essential to implement reforms that are holistic, practice-oriented and scientifically based. The following steps should be prioritised in this endeavour: policy stability, practice-oriented education, the presence of qualified faculty, and the strengthening of professional status.

3. Teacher Training Practices in the World

International comparisons show that practice-based training, continuous professional development, and adaptation to societal needs are decisive in the success of teacher training programs (Darling-Hammond, 2017; Asfahani et al., 2024; Darling-Hammond & Lieberman, 2012). In this respect, when looking at global practices, teacher training processes are a critical element that directly affects the quality of countries' education systems. According to OECD reports, teacher selection processes in high-performing education systems are highly selective, and admission to the profession is based on high academic and personal competencies (OECD, 2019). In countries with successful education systems, teacher training policies generally focus on high standards, practice-based training, and continuous professional development. In countries such as Finland, Singapore, and Korea, the acceptance rate to the teaching profession is low, but the quality of teacher candidates is high (Darling-Hammond, 2017; Darling-Hammond & Lieberman, 2012; OECD, 2019). In various countries around the world, the professional development of both prospective and current teachers is supported in a continuous

and planned manner through the teacher academies model (Grossman, 1990). An examination of the duration and model of teacher education reveals that teacher preparation programs in most OECD countries range from 3 to 6.5 years, and that these programs are generally conducted using a concurrent model. In this model, pedagogical formation courses are offered together with content knowledge courses (OECD, 2021). However, in some countries, a consecutive model is implemented, meaning that prospective teachers first receive content knowledge and then pedagogical training (OECD, 2021). Mentoring and in-service development programs are among the most important practices supporting the pre-professional education process. The OECD (2011) emphasizes that developing qualified teachers is not limited to initial education but should be supported by continuous professional development and career ladders. TALIS 2018 findings also indicate that teachers' participation in professional learning communities increases professional satisfaction and the quality of teaching (OECD, 2019). Digital competencies have recently become a prominent topic. According to an OECD (2023) report, nearly half of teachers do not feel competent to integrate digital technologies into their teaching. This suggests that the impact of technology on learning outcomes depends largely on teachers' pedagogical use.

With regard to working conditions, the OECD average class size is approximately 15 students in primary school and 13 in secondary school. However, in regions such as Latin America, this figure exceeds 25 (OECD, 2020). Moreover, while the official annual teaching load of teachers in OECD countries averages 700–780 hours, in some countries this load exceeds 1,000 hours (OECD, 2020). An analysis of the age demographic of teaching professionals within OECD countries indicates an ageing teaching population. As indicated by the OECD (2014), one-third of primary school teachers are over 50 years of age, with the average age of secondary school teachers increasing annually. In order to address this imbalance, it is essential that teacher training policies are adapted to appeal to young people and encourage them to pursue a career in the profession.

However, in low- and middle-income countries, the effectiveness of in-service training programmes implemented to enhance teachers' professional competencies varies significantly. Effective teacher training practices have been shown to include participation supported by career incentives, field-specific training, practice opportunities, and face-to-face instruction. However, as demonstrated in Table 2, such practices are not prevalent in many countries, and there is inadequate monitoring of teachers' professional development (Popova et al., 2018; Asfahani et al., 2024).

Table 2.

Basic Characteristics of Teacher Training Practices in the World

Dimensions	Key Features	Resources
Entry and Selection into Teaching	Entry into teaching in high-performing countries is highly selective; candidates are considered based on both their academic achievements and personal characteristics.	OECD (2011, 2019); Darling-Hammond (2017)
Structure of Curriculum	Field knowledge and pedagogical courses are taught in a holistic manner.	OECD (2021); Tatto et al. (2012)
Balance of Theory and Practice	Clinical models and school-based education are prominent.	OECD (2019); Zeichner (2010)
Professional Development	Teachers' lifelong learning is supported through professional learning communities, in-service training, and continuous development opportunities.	TALIS (2019); Avalos (2011)
Mentoring and Support	Mentorship is common for beginning teachers.	OECD (2019); Ingersoll & Strong (2011)
Digital Competencies	Teachers' technology integration skills vary. Digital pedagogical training is widespread.	OECD (2023); Mishra & Koehler (2006)
Working Conditions	Class sizes are low (15–13 students) on average in the OECD, and teaching loads range from 700–780 hours per year.	OECD (2020); Schleicher (2018)
Age Profile of Teachers	The teacher population in OECD countries is aging. Attractive policies are being developed to attract young people to the profession.	OECD (2014); Guarino, Santibañez & Daley (2006)

When countries with effective teacher training programmes are analysed in accordance with Table 2, a common characteristic emerges: namely, the high degree of selectivity in the selection of teacher candidates. In nations such as Finland and Singapore, teacher candidates are evaluated not only on their academic achievements but also on criteria such as personal qualities, motivation, and sense of social responsibility, ensuring that the most suitable individuals for the profession are selected (Darling-Hammond, 2017; Sahlberg, 2011). Teacher preparation programmes in these countries are characterised by a robust structure that integrates theory and practice; research-based clinical schools in Finland and school-based practices in Singapore have been shown to enhance teacher candidates' professional readiness (Zeichner, 2010; Tatto et al., 2012). Moreover, the objective is for educators to embody the qualities of professionals who, in addition to the dissemination of knowledge, engage in research and critical thinking. The fact that all teachers in Finland graduate with a master's degree is a

concrete example of this approach (Darling-Hammond & Lieberman, 2012). Professional development is also a continuous process in these countries; in Singapore, teachers participate in an average of 100 hours of in-service training per year, while in Japan, a collective learning culture is strengthened through lesson study practices (OECD, 2019; Stigler & Hiebert, 1999). Furthermore, robust mentoring systems have been developed for novice teachers, and in South Korea, the orientation process is supported by the guidance of experienced teachers (Ingersoll & Strong, 2011). In these countries, teaching is positioned as a profession with high social prestige and broad professional autonomy. This has been shown to increase interest in the profession and facilitate the orientation of qualified candidates to teaching (OECD, 2011; Sahlberg, 2011). The following section presents a comparative analysis of teacher training practices across various nations (see Table 3).

Table 3.

Comparison of Teacher Training Practices in Different Countries

Country	Teacher Training Institution	Education Process	Application	Functional Features
Finland	University Faculties of Education	Master's degree required	High	Research-based, critical thinking-focused
Singapore	National Institute of Education (NIE)	Post-graduate pedagogical training	Balanced	Centralized system based on national standards
England	Teaching Schools, Universities	Optional models such as PGCE, School Direct	High	School-based training, flexible programs
Germany	State Institutes	University + 2-year Referendariat	Very High	Practical training with observation and exam-heavy emphasis
Japan	Universities + Local Education Boards	Post-graduate teaching exam	Medium	Rigorous exams and ethics training are mandatory for teacher training
South Korea	National University of Education + Special Education Faculties	Post-graduate exam and internship	High	Disciplined and centralized structure, continuous performance evaluation
USA	Education Faculties,	Bachelor's + Certificate /	Variable	Different systems in each state, alternative programs

	Alternative Certifications	Master of Education		such as Teach for America are available
Netherlands	Universities of Applied Sciences (HBO)	Bachelor's level, school-based	High	Teachers begin practicing in schools early, with on-the-job learning being the priority
Türkiye	Education Faculties + Other Faculties (+forming education)	Bachelor's level	Medium	A corporate academy model is still in its institutionalization phase

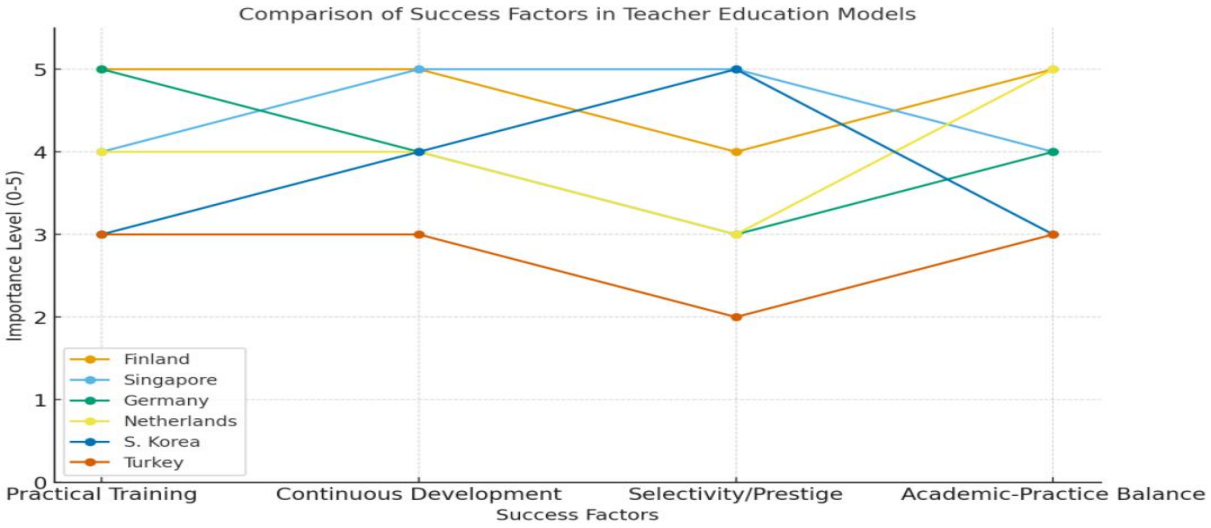
An examination of Table 3 shows that the high quality of teacher training systems is closely associated with selective candidate admission, the integration of theory and practice, and institutionalized professional development. In Finland, teaching is based on a master's degree supported by research-based and school-based practice, while professional autonomy and social prestige are strong. In Singapore, all candidates undergo centralized pedagogical training under the umbrella of the National Institute of Education (NIE), which integrates theory and practice and is complemented by systematic in-service training and career ladders, providing quality assurance. In the UK, the "teaching schools" model and multiple routes such as the PGCE/School Direct institutionalize continuous professional learning and leadership development by strengthening university-school collaboration. In Germany, the two-year post-university Referendaryat/Studienseminar process offers a professional maturation period based on theory concurrent with in-school practice, supported by examinations and observations. The most appropriate approach in the Turkish context, rather than directly copying these good examples, is; The aim is to design a hybrid model that adapts elements such as selective entry, clinical school partnerships, structured candidacy–mentoring, central capacity (similar to the NIE), a practice-intensive "residence" period as in Germany, and school networks that promote teaching leadership to local cultural and institutional conditions, supported by quality assurance and data-based evaluation.

3.1. International Success Elements in Teacher Training Models

Each country places varying emphasis on different success factors in its teacher training model. Figure 2 shows a comparison of some countries' teacher training models based on four success factors.

Figure 2.

Comparison of Success Factors in Teacher Education Models



The success of the teacher preparation models shown in Figure 2 is based on a common set of structural and pedagogical elements. Finland stands out as a country with highly selective entry into teaching, with all teachers receiving master's degree education. This adds academic depth to the teaching profession and positions teachers not only as knowledge transmitters but also as researchers and pedagogical experts (Sahlberg, 2011; Darling-Hammond, 2017). The Singapore model, on the other hand, has a centralized and planned structure in teacher preparation. All teachers are trained by the National Institute of Education (NIE), providing standardized quality assurance; moreover, teachers are offered gradual career development paths (teacher, senior teacher, lead teacher) throughout their careers (Goh & Lee, 2008; Darling-Hammond & Rothman, 2011). In Germany, teacher preparation includes a two-year practical internship called a "Referendariat," which goes beyond university education. This period provides a practice-focused formation process in which prospective teachers are evaluated through mentoring, observation, and examinations in real classroom settings (Terhart, 2011; Blömeke & Paine, 2008). In the Netherlands and the UK, teacher training is largely based on "school-based" learning; prospective teachers gain experience through extended observations and classroom practice in schools from the early stages of their education (Zeichner, 2010; McIntyre, 2009). In South Korea, teacher training is shaped by high competition and centralized control; teaching is seen as a prestigious profession, and prospective teachers are selected through highly challenging exams. This provides the profession with social prestige but also increases performance pressure on teachers (Kim et al., 2013; OECD, 2019). While Finland and Singapore place a high emphasis on practical training and continuous professional

development, South Korea prioritizes selectivity and professional prestige in entering the profession. While Germany stands out in its focus on practice, the Netherlands strongly emphasizes the academic-practical balance. Common success factors include long-term practical training (Finland, Germany, the Netherlands), continuous and voluntary professional development (Finland, Singapore), selectivity and quality assurance in entering the profession (Singapore, South Korea), and achieving a balance between academic and practical work (Finland, the Netherlands). The combination of these elements makes the teaching profession a highly qualified, respected, and sustainable career field, directly impacting the quality of educational outcomes (Darling-Hammond, 2017; OECD, 2019).

3.2. International Accreditation: Competencies and Achievements

3.2.1. Bologna and its competencies and achievements

The Bologna Process began in 1999 with the Bologna Declaration signed by 29 European countries in Bologna, Italy. Today, it is a collaborative effort encompassing 49 countries within the European Higher Education Area (EHEA) (Wächter, 2004). Türkiye joined the Bologna Process in 2001, completing the national qualifications framework for the higher education system that member countries are obligated to implement, and revising the curricula of higher education institutions based on these qualifications.

The qualifications defined for education faculties were designed to demonstrate what a successful graduate of any department would know, what they could do, and where they would be competent. Thus, they were designed to be recognized and correlated by national and international higher education institutions, enabling mutual diploma, grade transfer, and transfer. Learning outcomes were also established for this purpose. For clarity, a student must earn 240 ECTS credits to graduate from a department. This means, depending on the university's preference, a student must study 30 ECTS credits and 750-900 hours per semester, totaling between 6,000 and 7,200 hours to graduate. A student must study this many hours to complete 30 ECTS courses. The courses in a department and the outcomes of each course are clearly defined. These outcomes must align with the departmental outcomes. Universities develop their field qualifications based on the Turkish Qualifications Framework (TQF) [Türkiye Yeterlilikler Çerçevesi] and prioritize the skills they prioritize. Currently, neither the TQF nor the pages where universities announce achievements and competencies in their Bologna Information Packages contain any achievements or competencies related to teacher

training. Therefore, pedagogical formation courses are not included in the curriculum, and cannot be taken.

If additional elective courses are introduced without any changes to the existing curriculum, the student's workload will increase beyond their capacity. If these elective courses are replaced, the student will not acquire the skills and achievements necessary for graduation. Another dimension of the issue is that while regulations specify the number of ECTS credits students can take in a semester, and taking courses exceeding 30 ECTS is contingent on certain conditions, such as a high GPA, students are allowed to take courses up to 45 ECTS without any specific requirements. The lack of attention paid to other courses in pedagogical formation courses demonstrates the value placed on them by administrators.

3.2.2. International collaborations and educational exchange programs

International collaborations and educational exchange programs not only promote student and faculty mobility but also contribute to higher education institutions' goals of improving academic quality, developing research capacity, and supporting intercultural learning processes (Knight, 2004; Teichler, 2009). Especially in recent years, increasing knowledge sharing, developing global employment opportunities, and aligning curricula with international standards have become prominent among the primary objectives of internationalization in higher education (Altbach & Knight, 2007). When considered within the context of teacher training, such programs offer prospective teachers the opportunity to observe and apply pedagogical approaches in different countries. Furthermore, they make the teaching profession more respected and competitive internationally, encouraging collaborations among education faculties and enabling the development of partnerships in curricula and research (Altbach & Knight, 2007; Teichler, 2009). Thus, the professional competencies of prospective teachers are shaped not only by national standards but also by global criteria.

International collaborations and educational exchange programs stand out as important tools for transforming teacher training processes and professional development strategies. These programs enhance teachers' personal, professional, and intercultural competencies, particularly leading to significant improvements in areas such as language acquisition, cultural understanding, ease of integration in foreign environments, and teaching effectiveness (Oubit & Farahi, 2024). For example, Erasmus+ Teacher Academies aim to equip teachers with the skills to respond to contemporary educational needs, such as digital and green transformation, by establishing sustainable collaborations between teacher education institutions (European

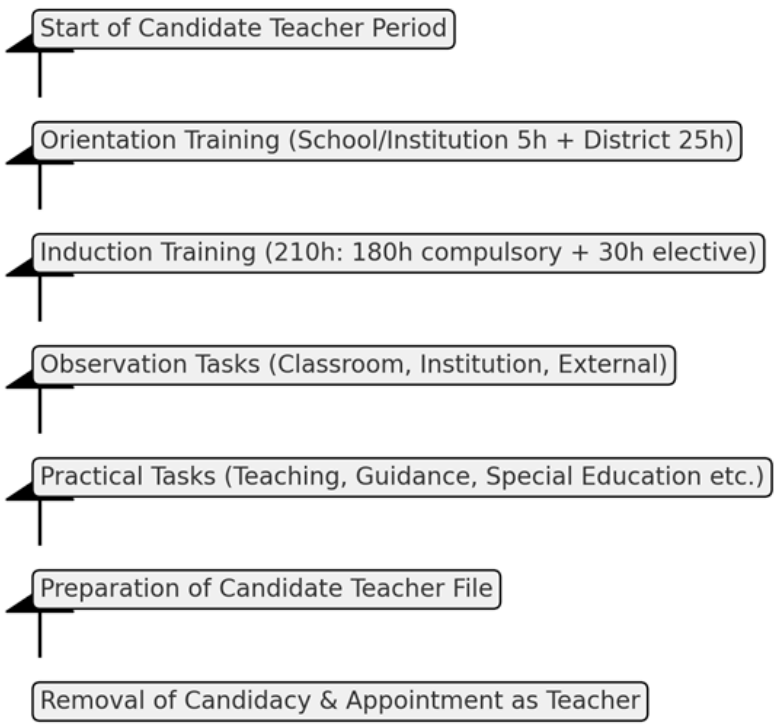
Commission, 2024). In this context, Erasmus+ Teacher Academies enhance the European dimension and internationalization of teacher education, support teachers' professional development, and contribute to the shaping of educational policies (European Commission, 2024). Consequently, international collaborations and educational exchange programs improve the quality of education systems by ensuring that teacher academies train modern and multicultural educators who comply with global pedagogical standards.

4. National Education Academy

The establishment of the National Education Academy by the Ministry of National Education on 1 January 2025 constitutes a substantial development in Türkiye's teacher training system. The National Education Academy has been defined as an institution responsible for the provision of preparatory training for prospective teachers, the conduction of in-service training for existing teachers, the assurance that said teachers receive training in fields such as head teachers and specialist teachers, the training of prospective administrators within the Ministry of National Education, and the development of policies related to teacher training (MEB, 2024). Accordingly, the process of training a prospective teacher can be summarised as follows:

Figure 3.

Candidate Teacher Training Process



The primary objective of the teacher candidate training programs at the National Education Academy is to facilitate the orientation of novice teachers by supporting their acquisition of professional knowledge, skills, attitudes, and values. The mentoring-based structure aims to provide individual, social, and professional support to novice teachers. This approach is expected to contribute to the well-trained development of teachers and their effective initiation into the classroom.

In line with the regulations in the National Education Academy regulations, the organizational structure of the teacher candidate training program is designed within a multi-actor, hierarchical system. The Ministry of National Education is the highest-level coordinator of the process. The Ministry determines the framework, content standards, and basic principles for the program's implementation. It also monitors the process based on data obtained from the provincial and district directorates of national education and takes corrective measures when necessary. At the local level, provincial and district directorates of national education conduct orientation training for novice teachers, coordinate the assignment of advisor teachers, and take the necessary measures to ensure the smooth completion of the process. Following the initiation of their teaching careers, educational institution principals appoint mentor teachers. They are responsible for implementing the induction process at the school level and directly guide the candidates' professional development. At the heart of this process, mentor teachers impart professional knowledge, skills, and values to the teacher candidates, observe their classroom and in-house practices, identify areas for development through formative assessments, and provide necessary guidance. Within this multilayered structure, teacher candidates are responsible for fully completing the training, observation, and practice tasks stipulated by the program. This entire structure aims to ensure a systematic, supervised, and guidance-based preparation process for the teaching profession.

4.1. Training Process and Appointment

The National Education Academy regulations state that admission to the National Education Academy will be based on the Academy Entrance Exam (AGS) score. The training program will consist of four terms, each term lasting 10 to 14 weeks. The academy offers prospective teachers a training program of approximately 550 hours (approximately one year). This program covers topics such as pedagogical formation, current educational approaches, technology integration, and student-centered education. Successful candidates will be appointed as contract teachers and will be eligible for permanent positions after three years. As defined in the guide, the teacher academy's training process is structured in two fundamental

dimensions to systematically support prospective teachers' orientation and professional development:

Orientation training aims to familiarize prospective teachers with the institution and environment in which they begin their work. Within this scope, a five-hour program organized at the school or institution level introduces the functioning of the educational institution, its organizational structure, the functions of its buildings and departments, and clarifies the prospective teacher's duties and responsibilities. In addition, 25-hour seminars conducted by provincial and district directorates of national education focus on the socio-cultural characteristics of the locality where the prospective teacher will work, the parent and student profile, and local needs. Thus, the total 30-hour orientation process is structured within a holistic framework to facilitate the prospective teachers' adaptation to both their institution and the social environment.

The induction training consists of a comprehensive 210-hour program delivered via distance learning. 180 hours of this program consist of compulsory courses and cover topics such as the Turkish education system, the structure of the Ministry of National Education and international programs, the foundations of education, student monitoring and evaluation processes, inclusive education, teacher professional ethics, legislation related to teaching, the Ministry of National Education Information Systems (MEBBİS), the reflection of culture and civilization on education, school-based disaster education, and the development of design and management skills in distance education. The remaining 30 hours consist of elective training, allowing prospective teachers to make choices based on their individual needs. These elective courses include current themes such as correct and effective use of Turkish, diction, environmental and zero-waste awareness, teaching in multi-grade classes, guidance services for children under temporary protection, human rights and democracy, and cybersecurity. Thus, the program offers multidimensional content aligned with both national priorities and global trends.

In parallel with these training processes, observation and practice assignments aimed at enhancing the professional experience of prospective teachers are an integral part of the program. Observation assignments allow prospective teachers to observe teaching practices in different contexts and learn from experienced teachers through in-class, in-house, and external activities. Practical assignments involve direct classroom activities, participation in guidance services, and participation in special education practices. Throughout this process, prospective teachers' activities are accompanied by the guidance and formative assessments of advisor

teachers, thus equipping prospective teachers with both theoretical knowledge and practical experience within an integrated educational model.

While the importance placed on orientation to the profession, the socialization of prospective teachers, and the acquisition of professional values can be emphasized among the strengths of the Turkish system, It has been noted that there are also disadvantages such as bureaucratic workload, the perception of candidate teachers as "interns," lack of additional pay, and limited summer vacation opportunities (Yıldırım & Özdemir, 2022). At the end of the candidacy process, candidate teachers are evaluated based on their candidacy files after completing at least one year of service and are appointed as permanent staff with the approval of the provincial governor's office. In this context, although Türkiye's candidate teacher system comprehensively structures the preparation process for the profession, when compared to international examples, it still has areas for improvement, particularly in terms of workload balance, the quality of field-based seminars, and the formalization of mentoring practices.

5. Basic Components That Must Be in the Teacher Training Process

Teacher training processes stand out as an important area of research in the international literature and exhibit significant differences across countries. Comparative studies have shown that Türkiye's teacher training system has some unique aspects when compared to the practices in China, New Zealand, and Germany. Research suggests that in China, New Zealand, and Germany, novice teachers are assigned a lesser workload and more time is allocated for professional training and development, while in Türkiye, novice teachers carry a similar workload to experienced teachers (Liu & Zhang, 2023). Furthermore, while training seminars in Türkiye have a general and liberal content, in other comparative countries, seminars specific to novice teachers' areas of expertise, branch-based seminars are conducted (Yıldırım & Özdemir, 2022). Mentoring practices are a common element across all countries, but in Türkiye, they are based more on individual experience sharing, while in Germany, China, and New Zealand, these processes are organized as more institutionalized, collaborative, and formalized structures (Schmidt, 2021; Liu & Zhang, 2023). An ideal teacher training process, with an academic framework and justified components, should aim to holistically develop prospective teachers' professional competencies, pedagogical knowledge and skills, evidence-based practice competencies, and motivation for continuous professional development. Within this framework, the process should include some of the key components listed in Table 4:

Table 4.

Components And Rationales of the Ideal Teacher Training Process

Component	Academic rationale and contribution	Resources
Evidence-based program and monitoring	Continuous improvement, accountability, quality assurance	(Plecki et al., 2012; Wineburg, 2006)
Field and pedagogical competence	Deep knowledge, effective teaching, professional standards	(Singh et al., 2021)
Practice-based education	Classroom experience, data literacy, evidence-based practice	(Beck et al., 2025; Chorzempa et al., 2019)
Continuing professional development	Lifelong learning, community building, adaptability to innovation	(Beardsley et al., 2023)

As demonstrated in Table 4, the optimal teacher preparation process is one that exhibits a dynamic and innovative structure, integrating evidence-based program development, robust field and pedagogical competence, practice-based training, and continuous professional development.

Evidence-Based Program Design and Continuous Improvement: The teacher preparation programme should be structured with an evidence-based approach that measures and improves the effectiveness of teacher preparation processes. The monitoring and evaluation of program outcomes, with the findings being used for continuous improvement, is essential for accountability and quality assurance (Plecki et al., 2012; Wineburg, 2006). This approach is not only responsive to external demands, but also conducive to the cultivation of internal knowledge production and collective responsibility (Plecki et al., 2012).

Content Knowledge and Pedagogical Competence: The ideal process for the preparation of prospective teachers should ensure that they possess strong subject matter knowledge and both general and field-specific pedagogical competencies. Research indicates that the optimal teacher is expected to possess extensive subject matter expertise, pedagogical proficiency, and practical competencies (Singh et al., 2021). In this context, it is imperative that programs integrate both theoretical and practical teaching processes.

Practice-Based Training and Field Experience: Internships and mentoring programs that allow prospective teachers to practise in real-world classroom settings are an essential part of professional development. Practice-based training has been shown to enhance prospective

teachers' skills in assessing student learning, making evidence-based decisions, and developing effective teaching strategies (Beck et al., 2025; Chorzempa et al., 2019). In addition, prospective teachers' data literacy and assessment competencies are among the fundamental elements of contemporary teaching (Beck et al., 2025).

Continuous Professional Development: Prospective teachers should be provided with the necessary tools and communities to facilitate their professional development beyond graduation. The establishment of professional learning communities is recommended, with the aim of providing teachers with a forum for the exchange of research-based practices, collaboration with their peers, and access to contemporary educational approaches (Beardsley et al., 2023). Such platforms have been shown to facilitate the adoption of evidence-based strategies by teachers, as well as their adaptation to professional innovations.

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CHAPTER 10

Accreditation in Teacher Training Programs: Ensuring Globality

Ayfer SU BERGİL

Chapter Highlights

- This chapter focuses on the role of the accreditation process in teacher training programs.
- The chapter examines the historical development of the accreditation process in teacher training at the local and global levels.
- The chapter highlights the key components of the accreditation process for teacher training programs.
- In this chapter, the attention has also been drawn to the future directions of local and global teacher training accreditation processes.
- Additionally, the challenges of accreditation practices in teacher training have been addressed, and the policy-practice dimensions of accreditation have been explored.

Abstract

It is an important issue to improve the quality of higher education institutions and the implemented educational programs to train the desired quality of human resources and to ensure this with ongoing practices. With its initial emphasis on institutions and progressing to its current focus on accountability, learning outcomes, and continuous improvement, this chapter aims to outline the evolution of accreditation in teacher training programs. It delves into the development of accreditation and quality assurance systems within teacher education. Moreover, the chapter provides a comprehensive overview of Türkiye's progress, emphasizing significant legislative changes, systemic functions, and policy shifts that have influenced the current accreditation framework. It also highlights widely accepted elements such as standards-based evaluation, continuous improvement, and feedback by employing comparative research and international standards. The chapter both emphasizes the procedural and structural elements crucial for effective evaluation, including self-assessment, peer review, external evaluation, and evidence-based reporting and suggests systemic challenges, such as cultural differences, political interference, financial limitations, uneven resources, resistance to external evaluation,

inconsistent evaluation methods, rapid technological advancements, and a lack of universal standards, which have the potential of impeding the implementation of cohesive quality frameworks in accreditation practices. In addition, the chapter highlights the significant impacts of accreditation processes on practice and policy by advocating for an approach to accreditation that is both context-sensitive and globally informed, capable of maintaining standards while encouraging regional innovation. The chapter concludes with valuable information for institutions, educators, and policymakers seeking to link historical context, global ideals, and current operational realities to improve the reliability and effectiveness of teacher education programs.

***Keywords**:* Accreditation, teacher education, universal aspects, key components, challenges, implications

Introduction

In an era marked by rapid global change and technological advancement, the quality of teacher education has emerged as a cornerstone in the development of effective education systems. Teacher training programs are tasked with preparing educators not only to master subject matter and pedagogy but also to navigate increasingly complex and dynamic classroom environments. Given the pivotal role that teachers play in student achievement and overall educational outcomes, ensuring the quality and accountability of teacher education programs has become a global priority (Tatto, 2015; Darling-Hammond, 2017). One of the most widely recognized mechanisms to uphold such quality is the process of accreditation.

Accreditation is a public recognition that the teacher training program has met the established standards of quality, effectiveness, and relevance set by the profession. It is more than just a bureaucratic formality, however, and is about a living process of development, accountability, and public confidence. Accreditation is a sub-system of quality assurance (along with others such as self/peer review, criteria and standards, and the use of indicators and benchmarks) that grew rapidly in importance throughout the latter decades of the 20th century, with the rise of demands for accountability and performance measures within education systems across the globe (Harvey & Green, 1993). Stakeholders, including governments, employers, students, teachers, teacher educators, and international organizations, started to demand mechanisms that could verify the standards of educational offerings as higher education institutions grew and diversified, especially in areas as socially significant as teacher education.

Because teacher training programs face unique challenges, robust quality assurance procedures are required. These issues include ensuring that curricula meet national education standards, preparing students for classrooms with diverse cultural and linguistic backgrounds, integrating new technologies into instruction, and promoting lifelong and reflective professional development. A variety of factors, such as student outcomes, faculty qualifications, curriculum design, institutional resources, and real-world application features, are examined by accrediting processes in order to meet these needs (CAEP, 2022). In addition to setting a standard for excellence, these assessments encourage institutions to conduct their own independent studies and external reviews.

Accreditation has also taken on a worldwide significance in the setting of globalization. Internationally recognized standards in teacher education are becoming more and more necessary as a result of the increased cross-border mobility of professionals and students. As a result, cooperative quality assurance initiatives and global certification frameworks have been created. In order to promote the harmonization of teacher education standards throughout nations, organizations like the OECD and UNESCO have underlined the significance of comparability and mutual recognition of qualifications (OECD, 2019). As a result, certification is now used to improve teacher training institutes' international recognition and competitiveness in addition to ensuring quality at the national level.

In addition, the professionalization of teaching as an occupation is highly accreditation-based. It flirts with the notion that we should hold teachers to the high bar we require in professions such as engineering and medicine, and talk about how we want to adequately prepare them. Accreditation agencies contribute to the knowledge base of the profession and create a culture of evidence-based practice by articulating what teacher candidates should know and be able to do (Cochran-Smith et al., 2016). As a result, teaching evolves into a reflective, research-driven profession that is grounded in theory while remaining attuned to the practical demands of the classroom.

It is imperative to recognize, however, that the accreditation process is not without its opponents and difficulties. Many argue that accreditation may become too bureaucratic, prioritizing adherence to rules over genuine improvement (Schmidtlein & Berdahl, 2005). Moreover, one must consider the drawbacks of rigid standards that might restrict institutional independence and innovation, particularly in varied sociocultural contexts where a uniform approach may not be suitable.

Teacher education has a crucial role in people's lives and shapes the standards of education in communities. In this regard, even though it is occasionally criticized, the accreditation procedure used to guarantee the standards of teacher education programs is essential to guaranteeing standard compliance and the long-term growth of teacher education. This framework enables institutions to examine their own internal operations and assess their strengths and weaknesses, despite the fact that the importance of some procedures and paperwork makes the process cumbersome and bureaucratic. This makes it feasible to design programs that help teacher candidates advance their professional, ethical, and practical skills in addition to their theoretical knowledge. So, instead of concentrating on accreditation's shortcomings (Kuhl & Ewell, 2010), it is critical to highlight its features that offer systematic quality assurance for the teacher training process.

By providing the function of accreditation in teacher education and the fundamental guidelines that govern this process, this chapter seeks to significantly advance the body of literature for accreditation in teacher training programs. For this purpose, the evolution of accreditation, both in Türkiye and pioneering samples in the world, focusing on the development and milestones in time, the future directions that needs to be taken into account by the stakeholders, universal aspects, key features followed during the process, challenges needed to be embraced and facilitated, and also implications for the policy and practice are the scope decided to be covered in this chapter. Because, rather than accepting it as a requirement, accreditation needs to be accepted as a wealth and chance for reaching prioritized merit in teacher education.

1. The Evolution of Accreditation Practices in Teacher Education

Over the past century, the accreditation concept in teacher education programs has experienced significant change. As it is known as a component of quality assurance in higher education, developing from casual peer reviews to structured systems managed by national and global governing bodies, this section will explore the historical progression of accreditation in teacher education, highlighting significant phases and transformative developments.

1.1. Early Developments: Informal Peer Evaluations

The origins of accreditation in teacher education date back to the late 19th and early 20th centuries in the United States and Europe. At that time, education systems were mostly localized, and teacher training lacked systematic regulation. Teacher preparation programs were primarily conducted in normal schools—institutions specifically established to train teachers for elementary education (Labaree, 2006). These schools were under state supervision

but did not adhere to uniform quality standards. Peer reviews were informal and often subjective, typically involving inspections by state officials or educators from nearby institutions.

In the United States, the emergence of professional associations in the early 20th century began to formalize accreditation processes. The National Education Association (NEA) was instrumental in advocating for standards in teacher preparation (Fraser, 2007). During this period, regional accreditation bodies also appeared, such as the North Central Association of Colleges and Schools (NCA), which started assessing institutional quality based on peer-reviewed criteria.

1.2. Post-War Expansion and the Rise of Standardization

After World War II, higher education experienced significant changes due to increased student enrollments and federal investments, particularly through the G.I. Bill (Loss, 2011). The demand for qualified teachers increased, leading to more scrutiny of teacher preparation programs. Accreditation moved towards standardization, with agencies like the National Council for Accreditation of Teacher Education (NCATE) established in 1954 to ensure consistent, high-quality teacher education across the United States.

NCATE introduced comprehensive standards covering faculty qualifications, curriculum design, assessment strategies, and institutional support structures (Imig & Imig, 2006). Its establishment marked a crucial point in the history of accreditation, shifting the process from institutional self-evaluation to rigorous, evidence-based assessments. By the 1970s, many state education departments required institutions to obtain NCATE accreditation for their graduates to qualify for licensure.

1.3. International Trends and Comparative Developments

While the United States led the way in formal accreditation systems, other countries developed similar frameworks. In the United Kingdom, the Council for the Accreditation of Teacher Education (CATE) was created in 1984 under the Department for Education and Science. CATE focused on ensuring that teacher education providers met centrally defined standards, particularly in subject knowledge and pedagogical skills (Whitehead et al., 2000).

In countries like Finland, the accreditation process is integrated within a highly centralized education system that entrusts universities with the responsibility of preparing teachers. Although Finland lacks a separate accreditation body, stringent national regulations and

continuous quality assurance mechanisms ensure program quality (Sahlberg, 2014). Similarly, Australia established the Australian Institute for Teaching and School Leadership (AITSL) in 2010, which governs national accreditation standards and program review protocols (AITSL, 2017).

A comparison of international accreditation systems is presented in Table 1 below.

Table 1.

Comparative Overview of Accreditation Systems in Selected Countries

Country	Accrediting Body	Key Features	Year Established
USA	NCATE (now CAEP)	Rigorous national standards, periodic review	1954
UK	CATE (defunct), now Ofsted	Centralized oversight, focus on accountability	1984
Finland	Ministry of Education	University-led, national regulation	N/A
Australia	AITSL	National professional standards for teachers	2010
Canada	Provincial Ministries	Decentralized, province-specific	Varies

1.4. The Era of Outcomes-Based Accreditation

Throughout the 1990s and 2000s, accreditation underwent a notable transformation towards outcomes-based education. This shift was influenced by larger educational reforms that emphasized accountability and the measurement of student learning outcomes (Darling-Hammond, 2012; Driscoll & Wood, 2023). Accreditation organizations began to assess not only the resources of institutions but also how effectively teacher preparation programs fostered competent teaching practices.

A significant change took place in 2013 with the shift from NCATE to the Council for the Accreditation of Educator Preparation (CAEP). CAEP included performance indicators, such as the influence of graduates on student learning and employer satisfaction, within its accreditation criteria (CAEP, 2022). This emphasis on factual evidence aligned accreditation

processes with international trends in quality assurance and educational efficacy. Nonetheless, this transition sparked some debates. Detractors argued that an overemphasis on measurable results could neglect the contextual and interpersonal elements of education (Cochran-Smith et al., 2013). Nevertheless, by the early 21st century, outcomes-based accreditation emerged as the dominant framework in numerous nations.

2.5. Digital Transformation and Future Trends

The worldwide digital revolution, alongside the rise of Web 2.0 and Web 4.0 technologies, has had a significant impact on teacher training programs, just as it does on all facets of educational systems (Redecker et al., 2011). The new learning environment created by Web 4.0 technologies calls for a flexible and adaptable curriculum approach in teacher preparation. In this case, the accrediting procedure must become a development guide that directs programs rather than merely a control mechanism. The degree to which the curriculum aligns with digital transformation, supports educational institutions' ongoing development, and boosts their competitiveness internationally should all be assessed by a qualified accreditation system. These days, data-based teaching apps, online interaction designs, digital literacy, and AI-supported learning resources are all essential parts of training for teachers. The certification procedures put in place to guarantee the quality assurance of teacher training institutions are also changing in tandem with these advancements; they now emphasize digital competencies in addition to pedagogical and field competencies.

Conventional types of accreditations are based largely on in-person instructional procedures. However, hybrid and fully online teaching approaches are now commonplace, and teacher candidates will inevitably work in technologically advanced classrooms. In this regard, a modern and forward-thinking accrediting system should also take into account the digital pedagogical abilities, critical thinking, and digital ethics skills, the ability to design individualized learning, and the comprehension of lifelong learning of teacher candidates. For instance, global initiatives such as the Bologna Process in Europe have facilitated the alignment of accreditation systems through frameworks like the European Qualifications Framework (EQF). These trends indicate a future where accreditation may increasingly become global and adaptable to emerging educational technologies and formats.

As a result, making teacher education compatible with the requirements of the digital age is possible with an effective, contemporary, and forward-looking accreditation process since the evolution of accreditation in teacher training programs reflects wider changes in educational

philosophy, governance, and technology. Remembering its beginning as a community-based peer evaluation method, it is accepted that the process has transformed into an outcomes-oriented quality assurance system informed by technology, which plays a vital role in defining teacher education. This process, as innovative educational frameworks and digital resources keep developing, not only provides quality assurance, but also has the potential to reshape the professional equipment of teacher candidates in line with the needs of the digital age to maintain the quality and relevance of teacher preparation globally.

3. The History of Accreditation in Teacher Training Programs of Türkiye

The creation of the National Teacher Training Committee (ÖYMK) to guarantee the required collaboration and coordination between the Ministry of National Education and the Council of Higher Education in the field of teacher training is one study that can be included within the scope of the studies that initially began in Türkiye in the 1990s and were intended to accredit teacher training programs. Ensuring a qualitative standardization in education faculties was one of the Committee's initial initiatives. The Committee researched the viability of this view and looked at the quality assurance systems put in place in the USA and England for this purpose after adopting the view at the meeting on November 12–14, 1998, that an accreditation system for quality assurance in teacher training was required. But when it came time to convert into a national accreditation system, this system—whose development was finished—was left to its fate at the level of Turkish higher education institutions. Consequently, the quality assurance systems that were attempted to be developed were insufficient to meet the EHEA (European Higher Education Area) standards at the level of higher education institutions in Türkiye, even though the Council of Higher Education made increasing efforts to establish a system using the Bologna process. However, as a result of the legislation that was later enacted and the attempts to raise awareness about certification, accreditation institutions like EPDAD (Eğitim Fakülteleri Programlarını Değerlendirme ve Akreditasyon Derneği—Association for Evaluation and Accreditation of Teacher Education Programs)—which is based on the program-based accreditation processes—were established. By correctly drawing conclusions about the institutions that provide teacher training within the parameters of the established requirements, EPDAD, which implements the evidence-based certification process, carries on with the accreditation process.

3.1. Early Accreditation Developments in Teacher Education in Türkiye

In the late Ottoman Empire, the groundwork for teacher education in Türkiye was established. The notion of teacher training was also impacted by the belief that changes to the educational system were necessary in light of the 19th-century modernization initiatives. In this regard, the first institutional step for teacher training in Türkiye was the opening of the Darülmuallimin (Male Teachers' School) in 1848. To address the need for female instructors in the next years, Darülmuallimat (Girls Teachers' School) was founded in 1870 (Akyüz, 2008). These schools were founded with the intention of defining teaching as a profession and supplying basic education institutions with skilled human resources.

Both instructional expertise and moral principles influenced the teacher training process. The premise behind early teacher training programs was that educators should serve as society's enlighteners. This notion gained institutionalization with the Republic's declaration and was reinforced by institutions like Teachers' Schools and Village Institutes. Nevertheless, during the early Republican period (1923–1950), systematic evaluations of the quality of teacher preparation programs were largely lacking, as the focus shifted to expanding educational access and fostering national identity through schooling. However, these early innovations helped teacher preparation in Türkiye expand over time and achieve its multifaceted structure today. Although Türkiye implemented several reforms aimed at modernizing its education system including the reorganization of education faculties within universities following the establishment of the Republic (Özoğlu, 2010), attempts at accreditation and assessing the quality and outcomes of these programs did not materialize until the 2000s, as part of Türkiye's wider initiatives to comply with international education standards, particularly those outlined by the European Higher Education Area (EHEA) through the Bologna Process.

3.2. Establishment and Role of EPDAD

The increasing need for accreditation tailored to specific disciplines resulted in the establishment of the Association for Evaluation and Accreditation of Teacher Education Programs (EPDAD) in 2012. EPDAD has been recognized by YÖKAK as a national quality assurance organization focused solely on teacher education programs. Its objective is to enhance the standards of teacher education by creating principles, performing program evaluations, and providing accreditation based on stringent criteria (EPDAD, 2023).

The evaluation model employed by EPDAD aligns with both national qualifications and international standards of excellence. It evaluates faculties of education through various

categories, including curriculum development, faculty credentials, student support services, facilities, program outcomes, and feedback from stakeholders.

Table 2.

EPDAD Accreditation Standards

Standard Area	Description
Program Design and Outcomes	Learning outcomes aligned with the national qualifications' framework
Teaching Staff	Faculty qualifications, development, and involvement in the program
Resources and Infrastructure	Adequacy of physical and digital resources
Monitoring and Evaluation	Continuous improvement based on data and stakeholder input
Governance and Management	Organizational structure and decision-making transparency

EPDAD has granted accreditation to numerous education faculties throughout Türkiye, establishing a standard for excellence in teacher training. By the year 2023, EPDAD had assessed more than 60 programs across the country (EPDAD, 2023). Its efforts have significantly impacted universities, motivating them to embrace student-focused, research-driven, and process-oriented methods in teacher education.

3.3. Milestones in Accreditation Policy and Practice

Several regulatory and institutional milestones have shaped the landscape of accreditation in Turkish teacher education:

- **2001**: Türkiye joins the Bologna Process, initiating reform in higher education.
- **2005**: YÖDEK is established to coordinate quality assurance.
- **2012**: EPDAD is founded as a discipline-specific accreditation body for education faculties.
- **2017**: YÖKAK replaces YÖDEK as the national accreditation authority, granting recognition to various quality assurance agencies, including EPDAD.

- **2021**: New regulations mandate periodic external evaluation of teacher education programs for reaccreditation.

These developments reflect a transition from informal quality control to structured, evidence-based accreditation models.

Figure 1.

Timeline of Milestones in the Teacher Education Accreditation Process in Türkiye

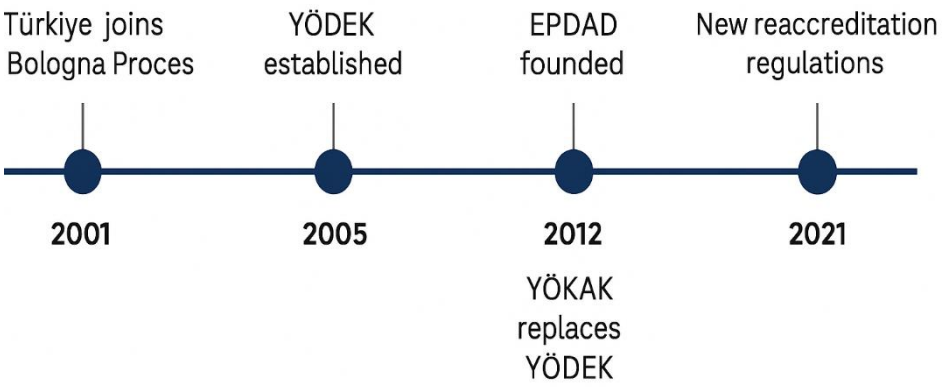


Figure 1 given above depicts the timeline of milestones in the teacher education accreditation process in Türkiye between 2001 and 2021. This process started with Türkiye's Bologna Process participation in 2001. Specifically, this participation triggered several comprehensive reforms aimed at higher education alignment with European standards. Following that, YÖDEK, establishing the groundwork for official quality assurance measures, was established in 2005. In 2012, EPDAD, the specialized accreditation organization, was established to assess teacher education programs in faculties of education in Türkiye. Then, in 2017, YÖKAK was founded and took the place of YÖDEK, acquiring greater autonomy and enhancing the national quality assurance system. Lastly, in 2021, new regulations were enacted that mandated periodic reaccreditation, indicating a move towards ongoing enhancements in teacher training programs.

3.4. Future Directions Considering the Historical Development of Accreditation

Although considerable advancements have been made throughout its history, challenges persist in accreditation processes. Numerous faculties continue to face difficulties in aligning traditional teaching methods with the learning outcomes and competencies required for 21st-century teacher education (Kaya, 2017). There is also a pressing need for better integration of digital skills, inclusive practices, and Web 4.0 tools into program standards, particularly in light of the disruptions caused by the COVID-19 pandemic. Nevertheless, the culture of evaluation is still evolving. Some institutions regard accreditation as a bureaucratic formality rather than a

chance for improvement. Fostering a mindset centered on continuous quality enhancement remains a significant challenge for EPDAD and YÖKAK.

Looking ahead, enhancing international collaboration, broadening interdisciplinary evaluations, and incorporating student input in accreditation decisions are among the suggested strategies to enhance quality assurance in Turkish teacher education (Adıgüzel & Sağlam, 2009). The progression of accreditation in Türkiye's teacher training programs mirrors the country's wider efforts to modernize and globalize its education system. From its historical roots in the Ottoman era to the founding of EPDAD and acknowledgment by YÖKAK, accreditation has evolved into a key component of teacher education reform. While there remain areas needing improvement, the establishment of a strong, standards-driven evaluation system signifies a crucial advancement toward ensuring that teacher training programs in Türkiye produce competent, reflective, and globally aware educators.

4. The Universal Aspects of Accreditation in Teacher Training Programs

Throughout the world, accreditation plays a vital role in guaranteeing the quality and accountability of teacher training programs. By assessing the institutions and programs against established standards to promote ongoing development, the accreditation refers not only to a process but also to an ideal designation. Having the ideal of accomplishing this, the accreditation process accepts universal principles that provide a basis for its foundation, although the systems in education differ across various nations (OECD, 2021).

The shared features of accreditation in teacher education that highlight globally recognized standards, as well as the continuous improvement and feedback components of this process, are the aspects that this section of the chapter delves into. When conceptualizing accreditation in teacher education, it refers to the official recognition given to institutions or programs that fulfill specified professional, academic, and institutional criteria. For this purpose, the aim is to guarantee that teacher candidates acquire the knowledge, skills, and attitudes required to address the needs of diverse learners in modern classrooms.

Another aspect that needs to be considered is that accrediting bodies vary in their structure and authority on a global scale. In the United States, organizations such as CAEP function based on principles devised in partnership with educators and policymakers. Conversely, in European contexts, such as Finland or Germany, accreditation is frequently linked with national quality assurance agencies and centralized educational policies (Eurydice, 2023). Despite the variances

based on context, several universal elements or principles characterize the accreditation framework in teacher training as follows:

4.1. Standards-Based Evaluation

Accreditation universally relies on clearly defined standards. These standards often encompass the following aspects as universal aspects:

- Curriculum quality
- Faculty qualifications
- Candidate performance
- Institutional capacity

Table 3 illustrates how these domains align across different countries.

Table 3.

Cross-National Accreditation Standards in Teacher Education (Adapted from UNESCO, 2022)

Domain	United States (CAEP)	United Kingdom (Ofsted)	Australia (AITSL)
Curriculum Quality	✔	✔	✔
Faculty Expertise	✔	✔	✔
Candidate Outcomes	✔	✔	✔
Institutional Input	✔	✔	✔

This table highlights the commonality of accreditation dimensions across various frameworks. The figure serves as a comparative table illustrating how four essential standards of teacher education accreditation are implemented in three distinct national systems: the United States (CAEP), the United Kingdom (Ofsted), and Australia (AITSL). Each country's column indicates whether its accreditation authority incorporates the corresponding standard into its teacher education evaluation framework. More specifically, curriculum quality guarantees that the teacher education curriculum is comprehensive, current, and aligned with national or international teaching competencies; faculty expertise necessitates that teacher educators

possess qualifications in both academic content and pedagogical methods; candidate outcomes evaluates how well-prepared teacher candidates are at graduation (e.g., teaching effectiveness, licensure rates); and institutional input examines the institutional infrastructure, governance, leadership, and resources available to support teacher education.

4.2. Continuous Improvement and Feedback

Globally, accredited programs are anticipated to cultivate an environment of introspection and adaptability. Rather than considering accreditation as a singular achievement, it is viewed as a continuous journey that fosters quality enhancement over time (Drake et al., 2021). Elements such as a culture of reflective practice, feedback mechanisms, action plans, ongoing data utilization, the significance of external reviews, surpassing basic standards, and a worldwide perspective on adaptability are integral components of accreditation cycles internationally focused on continuous improvement and feedback.

It is important to remember that the foundation of quality assurance in the accreditation process is continual improvement. This process considers things like curriculum updates, student feedback evaluation, teacher development, and digital and physical infrastructure improvements (Asiyai, 2022; Darling-Hammond et al., 2017). Institutions examine the current state of affairs, identify shortcomings, and attempt to take calculated actions in this direction while keeping these concerns in mind. The most fundamental objective of continuous improvement is to attempt to make quality sustainable over time, even when at first it appears to be implemented solely to meet criteria. The goal of this strategy is to make a significant institution like education more successful while also making sure that crucial roles are played in the institution's social responsibilities.

The quality assurance in the teacher education accreditation process is an ongoing development. In addition to assessing the existing conditions and situations, this process involves routinely reviewing and improving the curriculum, procedures, and results. By routinely gathering input from stakeholders (students, graduates, professors, school administrators, etc.), institutions can assess the success of their programs and use the information gathered to inform their decision-making. The validity, reliability, and transparency of measurement and evaluation systems are crucial at this time. In order to guarantee the operation of internal quality assurance systems, the active work of quality commissions at the unit level should be supported concurrently.

Feedback is a fundamental component of the teacher education accreditation process for continuous improvement. Feedback enables the identification of program shortcomings by

methodically gathering the opinions of stakeholders, including students, graduates, professors, and the business community. This keeps the quality assurance process dynamic and allows programs to be modified in accordance with needs. Feedback needs to be received frequently, openly, and in a variety of ways in order to be successful. It also needs to be examined and turned into specific improvement actions. This technique improves professional competencies and helps programs align with age-appropriate criteria (AITSL, 2021).

Models of universal accreditation are predicated on developmental and participative methods of quality control. For instance, organizations like the European Association for Quality Assurance in Higher Education (ENQA) in Europe and the Council for the Accreditation of Educator Preparation (CAEP) in the United States demand that teacher education institutions not only present performance data but also describe how they analyze it and how their findings help to improve the program. This helps make teacher education programs into self-reflective, self-learning, self-transforming organizations (CAEP, 2022) and nurtures ongoing improvement and feedback cycles.

The institutional culture has a direct impact on how well feedback and continuous improvement procedures operate. Accreditation is not only viewed as a formal requirement but also as an essential component of high-quality education because of the institution's positive understanding of quality assurance, the active involvement of the teaching staff in the process, and the management's development-oriented mindset. Otherwise, the certification process is unable to produce a true change and move beyond surface-level reporting.

As a result, in addition to responsibility, accreditation procedures in teacher education also provide a creative and adaptable definition of quality. Feedback cycles and continuous improvement stand out as the fundamental components that guarantee this process's universal operation (OECD, 2021). The successful implementation of these cycles makes it possible to prepare teacher candidates as persons who are prepared for both the present and future demands of education (UNESCO, 2022). This adaptive model not only ensures accountability but also empowers teacher education programs to innovate, reflect, and progress towards excellence.

5. Key Components of the Accreditation Process

The accreditation of teacher training programs is not simply a review process; it constitutes a thorough, evidence-based procedure that maintains academic integrity, professional responsibility, and institutional openness. It functions as both a quality assurance tool and a developmental framework, enabling educational institutions to meet changing local

and global demands for teacher training (Bourke & Ryan, 2023). Although accreditation processes may differ among countries and organizations, they all share a structured, multi-phase approach aimed at ensuring consistency, fairness, and advancement in teacher education.

Grasping the fundamental elements of the accreditation process is crucial not only for adherence to institutional standards but also for nurturing a culture of excellence and creativity in teacher education. These elements generally consist of self-evaluation, external peer assessment, on-site evaluations, decision-making processes, and ongoing monitoring; each playing a distinct role in enhancing the credibility and effectiveness of the accreditation cycle outlined below:

Figure 2.

The Accreditation Cycle

Self-Assessment (Self-Study): The accreditation process generally starts with a self-assessment report or self-study created by the institution or teacher education program being evaluated. This phase is arguably the most crucial, as it lays the groundwork for all later stages.

Self-assessment entails a systematic internal evaluation of the program's philosophy, design, implementation, resources, outcomes, and potential areas for enhancement. Institutions are required to ensure that their documentation aligns with national or international standards, including curriculum alignment, faculty qualifications, teaching methods, candidate evaluations, and the success of graduates (Oraison et al., 2019).

Beyond being a mere bureaucratic obligation, the self-study promotes organizational introspection. Throughout this process, questions arise about whether the programs are effectively preparing future educators and if their practices are informed by research and socially responsive. Therefore, as emphasized in CAEP 2022, the idea that "self-study should

not simply demonstrate compliance but also highlight a dedication to excellence and innovation in teacher education" must be prioritized.

External Peer Review: To evaluate the quality of teacher education programs, external peer review is a methodical assessment procedure carried out by subject-matter specialists from outside the organization. In the sphere of teacher education, these specialists are typically seasoned academics or educational administrators. Basic components, including the program's goals, content, instructional strategies, student accomplishment, and continuous improvement procedures are the main focus of the evaluation process.

Three steps are often involved in this process: the preliminary review, the field visit, and the report writing. The institution's self-evaluation report is examined in the preliminary review. Peer evaluators interview students, educators, and administrators during the field visit in addition to observing lessons. At the last phase, evaluators give a thorough assessment that highlights the program's advantages and shortcomings. This procedure aids in the creation of programs that adhere to the values of accountability and transparency (Drake et al., 2021).

On-Site (or Virtual) Visit: An on-site (or virtual) visit during the teacher education accreditation process entails the evaluation board observing and assessing the relevant institution in person. During these visits, stakeholders are interviewed, the accuracy of the papers the institution filed is checked, and the physical or virtual learning environments are assessed. A virtual visit is conducted remotely using video conferencing equipment, whereas an on-site visit is conducted by physically visiting the institution. This procedure aids in the final accreditation decision and permits a more thorough examination of the institution's adherence to the requirements.

During the visit, reviewers may:

- Participate in classes or training sessions.
- Conduct discussions with students, faculty, and administrators.
- Explore facilities and observe the technological resources available.
- Review assessment tools and instructional materials.

This comprehensive evaluation allows reviewers to determine whether the institution is fulfilling its mission and truly meeting the objectives outlined in its self-study.

Accreditation Decision: After the site visit and assessment, the review team creates an extensive report that is presented to the accrediting organization. The agency then makes an

official determination regarding the program's accreditation status based on this report. Accreditation outcomes may include:

- Full Accreditation (for a defined period, usually 2–3–5 years)
- Conditional or Provisional Accreditation (requiring certain improvements)
- Denial of Accreditation (if criteria are not satisfied)

Typically, a separate panel within the accrediting organization makes the decision to guarantee impartiality. Notably, the results are frequently made available to the public, promoting accountability and transparency (OECD, 2021).

Follow-Up Monitoring and Continuous Reporting: Accreditation should be viewed as a continuous commitment to quality rather than a one-off event. Programs that are accredited often need to provide annual updates or reports that showcase improvements, address feedback, and prove ongoing adherence to established standards. Monitoring methods can include:

- Updates regarding student achievement data
- Reports detailing initiatives for faculty development
- Adjustments made in reaction to accreditation feedback
- Adoption of new strategies informed by educational research

This stage guarantees that institutions are not only meeting basic standards but are also growing and enhancing their practices in response to societal demands, research developments, and best practices in education (UNESCO, 2022).

Ultimately, each element of the accreditation process—from self-evaluation to follow-up monitoring—is crucial in maintaining the integrity, relevance, and quality of teacher training programs. This process is designed not merely to assess compliance but also to cultivate a reflective, data-driven, and future-oriented educational environment. When carried out effectively, accreditation transforms into a journey that empowers teacher educators to provide more equitable, impactful, and globally competent education.

6. Challenges of Global Teacher Training Programs' Accreditation Practices

The demands of the 21st century and the quickly evolving nature of education have drawn attention to teacher education programs on a worldwide scale. At this time, it is crucial for teacher training programs—which are crucial to the increasingly globalized phenomenon of

education—to attain high quality, uphold it, and openly disclose aspects of accountability (Darling-Hammond, 2020). Currently, the idea of certification is being adopted widely as a means of establishing and upholding the aforementioned quality standards (CHEA, 2021).

Notwithstanding all of these benefits that have been highlighted and taken into account, accreditation comes with conflicts and difficulties that vary or are similar in different nations. These difficulties are likely caused by disparate educational policies, political ideologies, sociocultural backgrounds, and budgetary constraints. The commonly acknowledged problems and potential remedies to address them are the main topics of this section.

6.1. Lack of a Global Standard

One of the key issues facing global accreditation is the lack of a standardized framework for teacher training programs that is universally recognized. Although international organizations like UNESCO have suggested guidelines for quality teacher education (UNESCO, 2015), these guidelines are primarily non-binding and open to interpretation by individual nations. For example, the standards established by the Council for the Accreditation of Educator Preparation (CAEP) in the U.S. may not correspond with the expectations of the Quality Assurance Agency (QAA) in the U.K. or the National Assessment and Accreditation Council (NAAC) in India. As illustrated in Table 4, fundamental criteria such as assessment methods, training duration, and practical experience show considerable discrepancies among different countries.

Table 4.

Comparison of Core Accreditation Standards in Three Countries

Standard	USA (CAEP)	UK (QAA)	India (NAAC)
Clinical Practice	Minimum 10 weeks supervised	Embedded in program	20 weeks mandatory
Student Assessment	Performance-based, formative	Portfolio and written exams	Theory + practical evaluation
Faculty Qualifications	Doctoral preferred	Master's minimum	Master's with NET/SET

Adapted from CAEP (2023), QAA (2022), and NAAC (2021)

This discrepancy makes it more challenging for international cooperation and the movement of educators across countries, hindering initiatives aimed at standardizing the global teacher workforce.

6.2. Political and Policy Interference

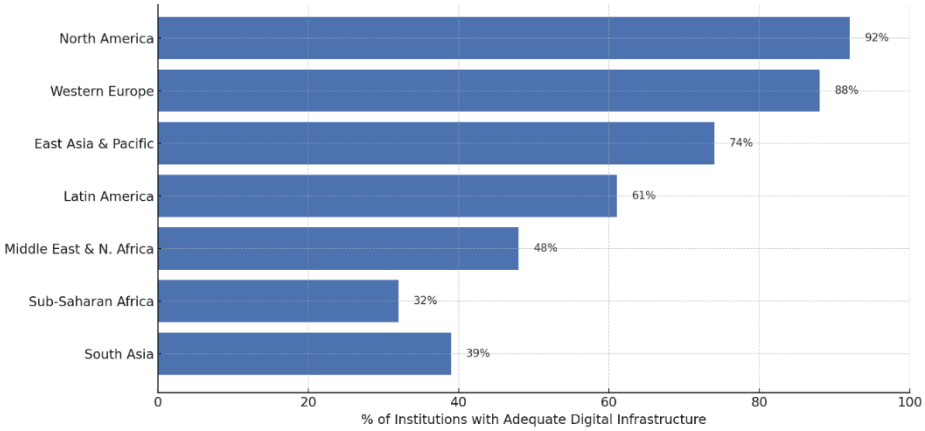
The processes involved in accreditation are frequently influenced—or even controlled—by government and political entities, rendering them vulnerable to changes in policies, leadership, or ideological perspectives. In various situations, independent accrediting organizations face pressure to align with political agendas, which can compromise their neutrality and dependability (Altbach, 2016). For instance, in certain countries, shifts in education ministers result in regular alterations to accreditation criteria, which disrupts the stability of assessments for teacher training programs. Additionally, trends toward privatization in some areas have led to the rise of non-accredited "for-profit" teacher training institutions, which erode trust in established accreditation systems (Levin, 2001).

6.3. Financial Constraints and Resource Inequity

Achieving accreditation is a costly and resource-demanding process. Institutions located in rural areas or low-income countries frequently lack the necessary infrastructure, personnel, and financial resources to satisfy accreditation standards, resulting in a disparity in quality between urban and rural or developed and developing institutions. A report by the World Bank (2020) indicates that over 32% of teacher education colleges in sub-Saharan Africa have limited access to digital resources, making it exceedingly difficult to meet even the fundamental technological requirements set by modern accreditation organizations, as illustrated below.

Figure 3.

Institutional Access to Digital Infrastructure in Teacher Education Programs by Region



Adapted from World Bank (2020), OECD (2019), UNESCO (2022b)

These inconsistencies prompt concerns regarding fairness in international accreditation, as organizations that truly prepare proficient educators might still face rejection for accreditation because of limitations that are specific to their context.

6.4. Resistance to External Evaluation

External evaluation mechanisms are typically included in accreditation procedures used in teacher education programs with the goal of quality assurance and ongoing growth. The opposition to outside assessment, however, is one of the most evident challenges this procedure faces (Newton, 2003). Numerous factors at the human, institutional, and cultural levels may contribute to this resistance.

Faculty and academicians may view external evaluation as an interference with their academic freedom. Because it disregards the particular context of institutions, deciding on evaluation criteria under a universal or centralized structure is criticized. Furthermore, the external review process adds to faculty members' workload, which causes anxiety about time and energy and may make them reluctant to go through the procedure. At the institutional level, a defensive attitude toward the external evaluation process is brought on by bad audit experiences in the past or a fear of getting low results.

The idea that evaluation is a tool for progress must be communicated in a clear and open manner in order to overcome this reluctance. In addition to being an audit, the evaluation process can be positioned as a chance for collaborative learning and development if stakeholders are actively involved. Furthermore, highlighting institutions' strengths and converting assessment results into actionable strategies for improvement helps boost confidence in external evaluation. Therefore, a crucial first step in raising the quality of teacher education programs is comprehending and effectively resolving opposition to external evaluation.

6.5. Inconsistent Evaluation Methods

The consistency of the evaluation methods used in the accreditation process of teacher education is of critical importance in terms of quality assurance. However, in practice, the interpretation and application of criteria in different ways between institutions and even within the same institution can cause inconsistencies in the evaluation processes (Harvey & Green, 1993). This situation makes it difficult to objectively monitor the development of teacher candidates and questions the reliability of accreditation outcomes. Differences of opinion among evaluators are frequently seen, especially in qualitative approaches such as portfolio

evaluations, teacher observations and interview-based measurements. In addition, the lack of measurement tools compatible with program competencies prevents the standardization of institutional evaluations (OECD, 2019). Systematizing evaluator training, creating standard rubrics, and putting in place ongoing feedback systems are crucial in this situation. In addition to boosting accreditation's dependability, consistent and open evaluation practices encourage a culture of ongoing development in teacher education.

6.6. Rapid Technological Changes

As we enter the era of Web 4.0 and AI-driven tools, teacher training initiatives are swiftly incorporating technology into their educational approaches. Nonetheless, accreditation organizations often fall behind these developments. Accrediting agencies find it challenging to revise criteria that correspond to blended learning environments, e-portfolios, online classrooms, and micro-credentials (Selwyn, 2019). This lag poses a risk of making accreditation models outdated, especially in institutions that are pioneers in adopting technology-enhanced teaching methods. Programs that push the envelope ahead of official standards may encounter penalties instead of support.

6.7. Cultural Contexts and Value Systems

Unfortunately, accreditation frequently overlooks the local sociocultural contexts. Effective teaching can vary greatly between different cultural environments. For example, approaches deemed learner-centered and innovative in Western nations might be viewed as disruptive in more traditional, collectivist societies (Walli, 1996). When accrediting organizations adopt a uniform approach, they risk stripping teacher training of its context, disregarding indigenous knowledge systems and cultural teaching methods, which leads to epistemological injustice (Andreotti, 2011).

If educational norms and practices from the West are enforced in non-Western settings due to this cultural disconnect, local educational customs and values may be compromised. Accreditation necessitates a more nuanced approach that appreciates and acknowledges the diverse cultural perspectives on education. This approach would involve collaborating with local educators and stakeholders to develop culturally sensitive certification standards that reflect the unique needs and values of each educational environment.

7. Conclusion and Implications for Policy-Practice Aspects of Accreditation

Global accreditation methods in teacher training programs are crucial for upholding quality and professional benchmarks. However, they face numerous obstacles, including varying standards, political influences, financial inequalities, reluctance towards evaluation, inconsistent metrics, slow technological adaptation, and cultural mismatches. In order to find solutions to these problems, the following measures are recommended to be implemented:

1- To standardize principles globally while taking local conditions into consideration, UNESCO or the OECD should spearhead the creation of a Global Accreditation Consortium.

2- International collaboration and financial support methods should be used to boost the capacity of organizations with limited resources.

3- It is necessary to adapt current evaluation frameworks to incorporate contextual, innovation-focused, and qualitative factors.

4- A development-oriented approach to accreditation should be used, and educational institutions and accrediting agencies should establish long-term feedback systems.

5- Adopting variable and technology-sensitive standards that work with emerging and evolving educational approaches is essential.

Global accreditation systems in teacher education can only develop really transformative, competent, and context-sensitive teachers if inclusive, adaptable, and egalitarian approaches are implemented. A new generation of educators who are not only competent in their profession but also sensitive to cultural diversity and capable of adapting to various learning contexts may emerge as a result of the implementation of such inclusive and sensitive practices. By implementing these tactics, teacher education programs will be better equipped to handle the opportunities and difficulties brought about by progressively different student profiles, which will help to create more specialized and successful teaching methods across the globe. It is also critical to keep in mind that standardizing the accrediting procedures for teacher education has significant ramifications for both the macro (policies and systems) and micro (programs and practices) levels. This can influence legislative laws and the course of investments in teacher quality at the policy level. At the program level, it boosts academic staff development, promotes curricular innovation, and enhances student services. Along with these, it is important to recognize the following implications.

Table 5.

Implications of Accreditation Across Stakeholders

Stakeholder	Implication
Policy Makers	Ensure alignment with international standards
Teacher Educators	Promote reflective teaching practices
Students	Receive quality-assured training and credentials
Employers	Gain confidence in the qualification of teacher graduates

Those consequences demonstrate how accreditation propels educational reform and quality control. As a result, the fundamental tenets of accreditation—standards-based assessment, continuous development, stakeholder participation, and quality assurance—are widely acknowledged despite the fact that teacher education programs differ globally. In addition to safeguarding academic standards, an efficient accreditation procedure guarantees that aspiring educators are prepared to handle the demands of classrooms that are becoming more multicultural and international. It is more important than ever to approach accreditation in a more uniform and equal way in the modern world of quickly advancing technology and growing worldwide mobility. The governments, educational institutions, and accrediting agencies must work together to take creative measures in order to create excellent and widely recognized teacher education systems.

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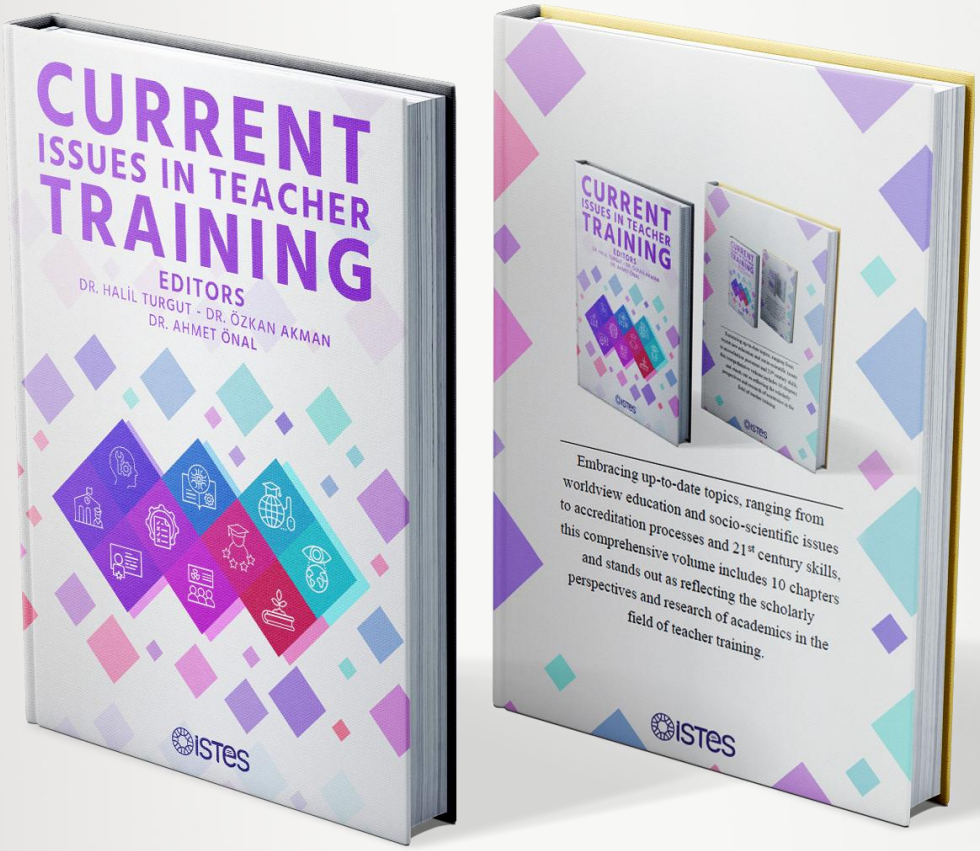

Embracing up-to-date topics, ranging from worldview education and socio-scientific issues to accreditation processes and 21st century skills, this comprehensive volume includes 10 chapters and stands out as reflecting the scholarly perspectives and research of academics in the field of teacher training.

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