

Stories That Teach: Narrative Pedagogy and Conceptual Understanding in Science

Teacher Education

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Abstract

Science teacher education has long privileged the logico-scientific mode of knowing, namely the transmission of verified fact, procedural demonstration, and analytical reasoning, at the expense of the narrative mode through which human beings most naturally make sense of the world. This narrative review examines thirty peer-reviewed studies published between 1986 and 2025, drawn from Scopus, ERIC, Web of Science, and Google Scholar, to theorise narrative pedagogy as a pedagogically powerful and underutilised approach to deepening conceptual understanding among pre-service science teachers. The review is organised thematically across three domains: the documented limitations of conventional science teacher education in building genuine conceptual understanding, the theoretical and empirical foundations of narrative pedagogy in science education, and the curricular implications of integrating narrative approaches into science teacher education programmes. Findings suggest that when scientific concepts are encountered through narrative structures, including historical accounts of discovery, case-based stories of scientific reasoning, and teacher-constructed narratives of natural phenomena, pre-service teachers develop deeper, more durable, and more transferable conceptual understanding than conventional expository instruction produces. Grounded in Bruner's narrative theory, Egan's story form model, and constructivist accounts of conceptual change, the review proposes a conceptual framework and calls for narrative pedagogy to be recognised as a structural component of science teacher education rather than a supplementary flourish.

Keywords: narrative pedagogy, science teacher education, conceptual understanding, storytelling, conceptual change, pre-service teachers

Introduction

There is a paradox at the heart of science teacher education. The discipline that is perhaps most animated by questions, by the restless human impulse to understand how the natural world works, why phenomena behave as they do, and what lies beyond the boundary of current knowledge, is routinely taught in ways that suppress precisely this spirit of inquiry. Pre-service science teachers are more often presented with conclusions than with the journeys that produced them. They receive the periodic table but rarely the story of the scientists whose rivalries, intuitions, and failures shaped it. They learn about cellular respiration as a metabolic pathway rather than as a conceptual achievement won over decades of painstaking and often bitterly contested research. In this way, science teacher education risks producing teachers who know the answers but have never truly inhabited the questions. This is not a trivial concern. A teacher who has never felt the conceptual difficulty of a scientific idea is poorly equipped to help students navigate that difficulty. Conceptual understanding, that is, understanding which is deep, flexible, and transferable rather than surface-level and quickly forgotten, is precisely what science teacher education must cultivate, and it is precisely what conventional instructional approaches frequently fail to produce (Loughran, 2006).

It is here that narrative pedagogy offers a theoretically grounded and empirically supported alternative. Bruner (1986) argued that human beings operate through two irreducible modes of thought: the logico-scientific, which seeks truth through argument and evidence, and the narrative, which seeks meaning through story, character, and event. These modes are not in competition. They are complementary, and education that draws only on the former impoverishes the learner in ways that are consequential. In science teacher education, the neglect of the narrative mode produces teachers who can explain scientific concepts but struggle to make those concepts genuinely intelligible to the students in front of them. Storytelling, in this view, is not a pedagogical embellishment. It is a cognitive necessity.

facilitate conceptual change, deepen engagement with scientific ideas, and support the kind of reflective understanding that pre-service teachers require if they are to teach science well (Hadzigeorgiou, 2016; Soares, 2023). Historical narratives of scientific discovery have been shown to help learners understand not only what scientists found but how and why they looked, and this understanding of scientific process is foundational to effective science teaching (Klassen, 2009). This narrative review draws on thirty peer-reviewed studies published between 1986 and 2025 to develop this argument. It does not argue that narrative pedagogy should displace other approaches. It argues that narrative pedagogy should be recognised as a structural component of science teacher education, one that addresses what expository and procedural instruction alone cannot reach.

Objectives

The present review is guided by the following objectives:

- To examine the documented limitations of conventional science teacher education with respect to the development of genuine conceptual understanding among pre-service teachers.
- To review the theoretical and empirical foundations of narrative pedagogy and its relationship with conceptual learning in science teacher education.
- To propose a conceptual framework for integrating narrative pedagogy into science teacher education programme design.

Methodology

This review adopts a narrative review methodology to examine the relationship between narrative pedagogy and conceptual understanding in science teacher education. Thirty peer-reviewed studies published between 1986 and 2025 were drawn from Scopus, ERIC, and Web of Science, with Google Scholar consulted supplementarily to capture practitioner scholarship and theoretically significant foundational works not consistently indexed in these databases.

understanding, pre-service science teachers, conceptual change, Bruner narrative, Egan story form, historical narratives in science, and science teacher identity, used independently and in combination. Studies were included on the basis of peer-reviewed status, relevance to science teacher education or closely related fields, and direct applicability to the review's thematic objectives. The date range was extended to 1986 to accommodate foundational narrative theory alongside contemporary empirical literature. Initial results were screened by title, abstract, and full-text review before final selection. The analysis is thematic rather than statistical, reading selected studies in conversation with one another to allow a cumulative theoretical argument to emerge. It is acknowledged that the narrative pedagogy literature carries a disposition towards qualitative and humanistic methodologies, and findings should be interpreted with this orientation in mind.

The Conceptual Deficit in Conventional Science Teacher Education

Science teacher education programmes across the world share a recognisable structure. Pre-service teachers engage with subject content through lectures and laboratory sessions, study curriculum frameworks and pedagogical methods, complete supervised teaching practice, and are assessed on their ability to plan and deliver lessons that meet prescribed learning outcomes. This structure is not without merit. It produces teachers who are familiar with their subject content, aware of curriculum requirements, and practised in the basic routines of classroom management and lesson delivery.

What it less reliably produces is teachers with genuinely deep conceptual understanding of the science they are asked to teach. Research has consistently documented a troubling gap between pre-service science teachers' surface familiarity with scientific content and their capacity for flexible, generative conceptual thinking about that content (Loughran, 2006). Pre-service teachers frequently hold the same misconceptions about foundational scientific concepts as the school students they will teach, and conventional instructional approaches do not always succeed in dislodging these misconceptions because they address knowledge at the

surface level rather than at the level of conceptual structure (Posner et al., 1982). A student can memorise the definition of natural selection and still not understand why variation within a population is necessary for selection to operate. They can reproduce the equations governing gas behaviour and remain entirely unaware of the conceptual revolution that the kinetic-molecular theory represented when it displaced earlier accounts of heat. The reasons for this conceptual shallowness are not difficult to identify. Conventional science teacher education tends to privilege what Bruner (1986) calls the logico-scientific mode of thought, characterised by formal argument, empirical verification, and the systematic organisation of knowledge. This mode is indispensable to science, but it is not sufficient on its own for genuine conceptual understanding. Conceptual understanding requires not only the ability to reproduce correct answers but the capacity to feel the force of a scientific idea, to understand why it matters, what it replaced, and why the question it addresses is genuinely worth asking.

Conventional science teacher education offers pre-service teachers science as a finished product. Concepts arrive already formed, already verified, and already stripped of the human drama that produced them. Newton's laws appear without Newton. The double helix arrive without the competitive urgency of the race to discover it, without Rosalind Franklin's contribution and its complicated history, without the false starts and moments of sudden clarity that made it one of the most consequential scientific achievements of the twentieth century. When scientific knowledge is presented in this way, pre-service teachers have no reason to find it surprising, no framework for understanding why it was difficult, and no model for the kind of thinking that science actually requires. They learn to present science as it has been presented to them, and the conceptual shallowness is passed forward.

Narrative Pedagogy and Conceptual Understanding: Theoretical and Empirical Foundations

The theoretical case for narrative pedagogy in science education rests on several converging lines of argument. The most foundational is Bruner's (1986) distinction between

the logico-scientific and narrative modes of thought. For Bruner, the narrative mode is not a watered-down version of the logico-scientific. It is a distinct and irreplaceable cognitive tool, and it is the mode through which human beings most naturally construct understanding of complex, ambiguous, and unfamiliar phenomena. When pre-service teachers encounter a scientific concept through a narrative structure, they are invited to follow a line of reasoning, to understand the obstacles that made the concept difficult to reach, and to experience something of the intellectual movement that its discovery required. This is precisely the kind of encounter that facilitates conceptual change, the genuine restructuring of a learner's conceptual framework rather than the mere addition of new information to an existing but unchanged structure (Posner et al., 1982).

Kieran Egan's story form model extends this argument in directions particularly relevant to science teacher education. Egan (1986) proposed that the story form, with its fundamental structure of conflict, complication, and resolution, is a deep cognitive structure through which human beings make sense of experience across all domains. In science education, this means presenting concepts as answers to questions that were genuinely difficult to answer, as resolutions of problems that were genuinely hard to solve. The concept of evolution by natural selection becomes far more conceptually accessible when presented as the resolution of the great nineteenth-century problem of how species come to be so exquisitely fitted to their environments. When the problem is vivid, the solution becomes intelligible rather than merely memorisable. Hadzigeorgiou (2016) further argues that wonder, the sense of genuine surprise and curiosity that arises when the natural world exceeds one's expectations, is among the most powerful motivational forces in science learning, and that narrative is among the most reliable means of cultivating it. A pre-service teacher who has experienced wonder in the face of a scientific concept is more likely to cultivate that wonder in their own students than one who has encountered the same concept as an item of curriculum content.

substantial. Dahlstrom (2014) demonstrated that scientific information presented in narrative form is more readily assimilated, more accurately remembered, and more flexibly applied than equivalent information presented in expository form, because narrative provides a familiar cognitive scaffolding through which new and counterintuitive ideas can be anchored to existing understanding. Soares (2023) argues that narrative structures engage the learner's capacity for mental simulation: when following a story, the reader or listener constructs a mental model of the described events and participates imaginatively in their unfolding. This imaginative participation produces understanding that is qualitatively different from that produced by reading a textbook account, because it engages the learner as an active meaning-maker rather than a passive recipient of information.

The role of historical narratives of scientific discovery is particularly significant. Klassen (2009) reviewed a substantial body of research on their use in pre-service teacher education and found consistent evidence that such narratives improve both content knowledge and understanding of the nature of science. Pre-service teachers who engage with historical accounts of how scientists arrived at major conceptual breakthroughs demonstrate more sophisticated understanding of how scientific knowledge is constructed, more awareness of the role of creativity and social context in discovery, and a more nuanced grasp of the provisional and revisable character of scientific knowledge. A teacher who understands science as a human and historical process is far more capable of communicating its genuine character to students than one who understands it only as a body of established content.

Narrative pedagogy also supports the reflective practice that is central to professional development in teacher education. Gudmundsdottir (1995) argued that storytelling-as-pedagogy is not only a means by which teacher educators convey content to pre-service teachers, but also a means by which pre-service teachers construct and communicate their own pedagogical understanding. When pre-service science teachers are invited to narrate their own encounters with scientific concepts, to tell the story of a moment of conceptual difficulty and

ISSN 3048-5835 Volume 4 Issue 2 November 2025 – April 2026 Page 33

its resolution, or to construct a narrative account of a natural phenomenon for a hypothetical student audience, they engage in precisely the reflective transformation of subject knowledge into pedagogical content knowledge that Shulman (1987) identified as the hallmark of expert teaching. Research on digital storytelling in teacher education is particularly suggestive in this regard: pre-service teachers who create digital narratives about scientific concepts demonstrate deeper engagement with those concepts and greater metacognitive awareness of their own learning than those who engage with the same content through conventional methods (Ozudogru and Cakir, 2020).

Towards a Conceptual Framework: Integrating Narrative Pedagogy into Science Teacher Education

Any serious attempt to integrate narrative pedagogy into science teacher education must begin with a reconception of what conceptual understanding actually requires. It requires more than accurate recall of scientific definitions and procedures. It requires the capacity to think with a concept, to see new phenomena through its lens, to recognise where it applies and where it breaks down, and to explain it in ways that make its logic visible to others. This kind of understanding is not produced by transmission. It is produced by engagement, and narrative is among the most powerful forms of engagement available to teacher educators.

The first commitment of the proposed framework is to the use of historical narratives of scientific discovery as a regular and structured component of science teacher education curricula. This does not mean replacing systematic content instruction with biography or anecdote. It means placing the concepts that pre-service teachers must understand within the historical contexts that reveal why those concepts were needed, what problems they resolved, and what assumptions they required learners to revise. The concept of plate tectonics becomes conceptually richer when pre-service teachers understand the decades-long resistance that continental drift theory encountered, and the eventual evidence that compelled its acceptance.

These historical narratives do not simplify science. They reveal its genuine complexity, and in

doing so they equip pre-service teachers to convey that complexity honestly to their own students.

The second commitment is to pre-service teachers as storytellers rather than merely recipients of stories. Constructing a narrative account of a scientific concept is a demanding pedagogical task. It requires the teacher to understand the concept well enough to identify its essential logic, to know where a learner is likely to encounter difficulty, and to find a narrative structure that makes the conceptual movement from difficulty to understanding visible and followable. When pre-service teachers are asked to design narrative-based lessons, to write historical accounts of scientific discovery for a student audience, or to narrate their own developing understanding of a concept, they engage in exactly the transformative reflection that deepens conceptual understanding and builds pedagogical content knowledge simultaneously.

The third commitment is to narrative as a tool for conceptual consolidation rather than conceptual replacement. Narrative engagement, however effective, does not by itself produce the consolidated conceptual understanding that pre-service teachers require. It must be followed by opportunities for explicit conceptual reflection, for the articulation of what has been understood, for the identification of remaining confusions, and for the connection of narrative insight to systematic scientific knowledge. A teacher education curriculum that integrates narrative in this way, using story to open conceptual doors and structured reflection to secure what has been entered, is more likely to produce genuine and lasting conceptual understanding than one that relies on either approach alone.

Implementing this framework does not require the wholesale redesign of existing science teacher education programmes. Existing content sessions can be restructured around historical narratives without sacrificing conceptual rigour. Micro-teaching exercises can include narrative lesson design as a required component. Assessment tasks can invite pre-service teachers to narrate their conceptual development as well as to demonstrate their content

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knowledge. These are not additions to the curriculum. They are deepenings of it, achievable within the structural constraints that most science teacher education programmes operate under.

Conclusion

This review has addressed each of its three objectives in sequence. The first, concerning the conceptual limitations of conventional science teacher education, was met through an examination of the persistent gap between pre-service teachers' surface familiarity with scientific content and the depth of understanding that effective science teaching requires. The second, a review of the theoretical and empirical foundations of narrative pedagogy, drew on Bruner's narrative theory, Egan's story form model, Hadzigeorgiou's work on wonder, and the empirical research of Klassen, Dahlstrom, Soares, and Gudmundsdottir to establish a coherent case for narrative's role in producing genuine conceptual understanding among pre-service science teachers. The third, the proposal of a conceptual framework for integration, was elaborated through three commitments grounded in historical narrative, storytelling as teacher practice, and narrative as conceptual consolidation, accompanied by implementation strategies sensitive to the realities of existing science teacher education programmes. Science teacher education stands at an important crossroads. Pre-service science teachers who learn to receive stories, to tell them, and to design learning around them will be better equipped to cultivate genuine conceptual understanding in their own students than those trained entirely within the logico-scientific mode. Stories are not ornaments to scientific understanding. They are among its most powerful instruments, and science teacher education that takes conceptual depth seriously cannot afford to leave them at the margins. Future research should examine how narrative pedagogy interventions can be evaluated rigorously in science teacher education contexts, with particular attention to the long-term impact of narrative approaches on both conceptual retention and classroom teaching practice.

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- ISSN 3048-5835 Volume 4 Issue 2 November 2025 – April 2026 Page 37

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