*Corresponding Author's Email: shanghaitan12318@163.com
Proceedings of the International Conference on Modern Research in Education, Teaching and Learning, Vol. 4, Issue. 1, 2025, pp. 31-51
DOI: https://doi.org/10.33422/icmetl.v4i1.1448

ISSN: 2783-7734 online

Diamond Scientific Publishing

A Dynamic Framework of Path Dependence Mechanisms in E-STEM Education Reform: Evidence from the UK's Locked-in Curriculum

Chenyang Yin

School of Social and Political Science, University of Edinburgh, Scotland

Abstract

This article develops a dynamic theoretical framework to analyze path dependence mechanisms in E-STEM (Environmental-STEM) education reform, focusing on England's notable resistance to curriculum integration as a critical case study. By incorporating the critical juncture theory, we explore how principals and educational researchers can leverage policy windows to disrupt entrenched practices and break the cycles of stagnation. Combining historical institutionalism with critical policy sociology, we identify three interrelated mechanisms that sustain disciplinary dominance: (1) epistemic lock-in perpetuated by high-stakes assessment regimes, (2) institutional isomorphism in teacher professionalization that limits innovative practices, and (3) corporate-state symbiosis in educational publishing that prioritizes traditional content. Through a qualitative analysis of policy documents from 2010 to 2023 and assessment databases, we reveal how these mechanisms create an "iron triangle" that resists reform. Importantly, we highlight that path dependence operates not merely through inertia but through the active reproduction of vested interests, thereby contributing to education policy theory and offering actionable strategies for sustainable curriculum transformation.

Keywords: path dependence, E-STEM education, UK policy analysis, assessment regimes, institutional change

1. Introduction: The Paradox of E-STEM Reform in England

The accelerating climate crisis (IPCC, 2023) has exposed a critical contradiction in England's education system: As YouGov (2019) reports, 76% of teachers support integrating climate education into the national curriculum. However, systemic barriers including high-stakes testing pressures and limited resources prevent widespread implementation, with only an estimated 32% of teachers regularly incorporating climate content into their teaching (Greer et al., 2023, B; Howard-Jones et al., 2021). This disconnect highlights a fundamental policy-practice gap where rhetorical commitments to environmental sustainability (DfE, 2021) clash

with institutional structures that actively marginalize interdisciplinary E-STEM learning (Dunlop et al., 2022).

This study interrogates why England's E-STEM (Environmental-STEM) reforms remain stagnant despite global pressure for climate education. We advance a dynamic framework of path dependence, synthesizing historical institutionalism (Pierson, 2000; Streeck & Thelen, 2005) with critical policy sociology (Ball, 2021; Foucault, 1995) to reveal how three interlocking mechanisms： assessment regimes, teacher training, and corporate publishing interests jointly sustain an "iron triangle" of institutional stasis.

1.1. Research Gaps in Existing Literature

Prior studies on E-STEM education reform have identified key barriers but remain limited in three critical ways:

1.1.1 Overemphasis on Structural Inertia

Most research attributes reform stagnation to historical path dependence (Pierson, 2000) or policy feedback loops (Béland et al., 2022), neglecting how active institutional reproduction occurs through: discursive strategies (e.g., framing climate education as "non-core"), corporate lobbying (e.g., Pearson's influence on GCSE content) and assessment dominance (e.g., Ofqual's reliance on exam board expertise).

1.1.2 Lack of Integrated Power Analysis

While Ball (2021) critiques neoliberal education governance and Foucault (1995) examines disciplinary power, few studies bridge these perspectives to explain how: market force (e.g., textbook monopolies) intersect with state policy (e.g., Teachers' Standards) and discourse (e.g., "rigorous subject knowledge") naturalizes institutional exclusion.

1.1.3 Limited Empirical Focus on Policy Enactment

Most analyses focus on classroom-level barriers (Howard-Jones et al. 2021) or international comparisons (Durazzi & Geyer, 2020), but few examine how national policy architectures (e.g., DfE's Sustainability Strategy) interact local resistance/innovation (Greer et al., 2023, B).

1.2. Methodology: A Qualitative Single-Case Study of England

To address these gaps, we employ a qualitative single-case study design (Yin, 2018), analyzing England's E-STEM policy landscape through:

1.2.1. Critical Policy Document Analysis

DfE (2021) Sustainability Strategy: Examines how climate education is framed as voluntary rather than mandatory.

GCSE Subject Content (DfE, 2014-2023): Tracks epistemic marginalization.

Teachers' Standards (DfE, 2011-2021): Reveals how subject purity mandates suppress interdisciplinary teaching.

1.2.2. Institutional Power Mapping

Ofqual (2022) Market Report: Exposes corporate-state symbiosis.

Policy Network Analysis: Traces lobbying influence on curriculum design (Ball, 2021).

1.2.3. Theoretical Triangulation

We integrate historical institutionalism (Pierson, 2000) to explains why structures persist, Foucauldian discourse analysis (Foucault, 1972) to reveals how knowledge hierarchies are constructed and critical policy sociology (Ball, 2021) to uncovers who benefits from institutional stasis.

1.3. Policy Documents Selection Criteria

Our analysis centres on DfE (2021), GCSE content (2014-2023), and Teachers' Standards because they collectively shape the educational landscape in significant ways.

Firstly, they define legitimate knowledge. The Sustainability Strategy (DfE, 2021) positions climate education as peripheral (e.g., emphasizing "extra-curricular activities" over curriculum reform). GCSE subject content (DfE, 2014-2023) institutionalizes disciplinary silos, with climate topics fragmented across subjects (e.g., carbon cycle in Biology only).

Second, these documents structure teacher agency. The Teachers' Standards (DfE, 2011-2021) enforce narrow subject expertise, omitting interdisciplinary or sustainability competencies. Ofqual's market report (2022) shows how publisher monopolies constrain pedagogical innovation.

Finally, our analysis expose policy contradictions while DfE (2021) claims to prioritize sustainability, GCSE reforms (2023) added only optional climate modules demonstrating symbolic vs. substantive policy (Edelman, 1985).

1.4. Research Questions

This study examines:

How do assessment regimes (GCSEs), teacher training (PGCE), and corporate publishing jointly sustain path dependence in E-STEM education?

What strategic openings exist for disrupting this "iron triangle" of institutional stasis?

1.5. Contribution to Theory and Policy

This study advances critical institutionalism by:

- Theoretically: Bridging Pierson's structuralism with Foucault's power analytics to show how path dependence is actively reproduced.
- Empirically: Mapping the DfE-Pearson-Ofqual nexus as a case of corporate-state symbiosis in education governance.
- Practically: Identifying policy leverage points (e.g., reforming Teachers' Standards, breaking publisher monopolies).

By combining qualitative policy analysis with power-structure mapping, we provide a framework for understanding and ultimately disrupting institutional barriers to E-STEM reform.

2. Theoretical Framework: Advancing Path Dependence Theory Through Critical Institutionalism

This section advances a critical neo-institutionalist framework that reconceptualizes path dependence as an active process of institutional reproduction rather than passive historical inertia. Building upon but substantially extending conventional path dependence theories (Pierson, 2000; Streeck & Thelen, 2005), we synthesize insights from three theoretical traditions to explain the persistent barriers to E-STEM education reform in England. Our framework makes four key theoretical interventions that address fundamental limitations in existing institutional analysis.

2.1.Theoretical Foundations

2.1.1. Extending Historical Institutionalism

Our framework integrates and extends three theoretical perspectives through a dialectical approach that bridges structural and discursive analyses of institutional persistence. This synthesis transcends conventional path dependence theories, fostering a more nuanced understanding of how educational systems resist transformative change.

Building on Pierson's (2000) seminal work on increasing returns, we identify three critical dimensions that are often under-theorized in traditional institutional analysis. First, we highlight power asymmetries in institutional reproduction, contra Pierson's (2000) functionalist tendencies, we demonstrate how path dependence is actively maintained through asymmetrical power relations between: policy elites and frontline educators (Ball, 2021), corporate actors and regulatory bodies (Hacker & Pierson, 2010) and assessment regimes and knowledge producers (Foucault, 1995).

Second, we explore the discursive dimensions of institutional stasis, by complementing structural analyses, we reveal how: policy language constructs "common sense" boundaries around legitimate knowledge (Schmidt, 2008), institutional vocabularies naturalize disciplinary silos (Fairclough, 2003) as well as silence on certain issues (e.g., climate justice) becomes politically significant (Foucault, 1995). Third, we address the temporal complexities in change processes, moving beyond linear models to analyze polychronic institutional rhythms across different policy domains (Thelen, 2009), non-synchronous development of reform initiatives (Streeck & Thelen, 2005) and simultaneous stasis and change at various system levels.

2.1.2. Critical Policy Sociology

Our framework also critically engages with existing typologies of institutional change, While Streeck and Thelen's (2005) seminal typology of institutional change (displacement, drift, layering, conversion) provides crucial analytical nuance, our framework demonstrates how their approach requires substantive supplementation: governmentality of institutional reproduction, mechanisms of complicity and material-discursive feedback loops. We incorporate Foucault's (1991) concept of governmentality to reveal: how examination systems function as disciplinary technologies that produce compliant subjects, the micro-physics of power operating through assessment criteria and mark schemes and ways in which teachers internalize and reproduce institutional logics (Ball, 2021). Our analysis unpacks the processes through which: frontline educators become unwitting agents of institutional stasis (Ball et al., 2012), policy discourses construct limited horizons of the possible (Schmidt, 2008) as well as market forces shape professional identities and practices (Ball, 2021). To illustrate material-

discursive feedback loops we extend Pierson's (1993) policy feedback theory by showing how: discursive constructions generate material consequences (e.g., funding allocations), resource distributions reinforce particular knowledge hierarchies. Similarly, Hacker and Pierson's (2010) "winner-take-all" politics illuminates how corporate-state symbiosis (Publisher-Ofqual-DfE nexus) blocks reform. Meanwhile, Thelen's (2009) analysis of gradual transformation reveals how teacher training systems convert reform pressures into mechanisms of stasis and why "critical junctures" often reinforce rather than disrupt path dependence. Both symbolic and material factors interact to maintain path dependence.

2.1.3. Theoretical Innovations

This synthesis makes several significant theoretical innovations, showing that path dependence arises not from passive inertia but from the active maintenance efforts of vested interests, the deliberate policing of knowledge boundaries, and the strategic deployment of institutional rules. Moreover, our framework integrates analyses across macro-level structural constraints, meso-level organizational dynamics, and micro-level discursive practices, thus developing a sophisticated understanding of institutional time that accounts for multiple coexisting temporalities and explains why critical junctures often reinforce rather than disrupt path dependence.

2.2.Mechanisms of Institutional Reproduction

Our analysis identifies three mutually constitutive mechanisms that sustain path dependence through active reproduction:

2.2.1. Epistemic Lock-In through Assessment Regimes

The GCSE examination system functions as what Foucault (1995) termed a dispositive, an apparatus of power that simultaneously: materially structures knowledge hierarchies, discursively constructs disciplinary boundaries through "rigor" narratives (Ball, 2021) and economically incentivizes compliance through school accountability metrics (Greer et al., 2023, B). This creates what Streeck and Thelen (2005) term institutional layering where climate education is technically permitted but structurally marginalized through: item banking systems that privilege legacy content mark schemes that penalize interdisciplinary responses and performance metrics that reward narrow subject mastery. To further explain how assessment shapes knowledge legitimacy, we also incorporate Bernstein's theory of "pedagogic discourse" (Bernstein, 2000). Bernstein argues that educational knowledge is constructed through "classification" and "framing," with assessment serving as a key mechanism. The GCSE's strong classification (rigid subject boundaries) and strong framing (weak teacher control) reinforce disciplinary isolation while excluding the interdisciplinary integration essential for climate education.

2.2.2. Institutional Habitus Formation

Teacher professionalization systems (PGCE) inculcate a disciplinary habitus through: regulatory mandates namely Teachers' Standards' narrow "subject knowledge" requirement (DfE, 2021), mimetic pressures meaning that the majority of programs replicate publisher-derived pedagogies and normative controls which refer to Ofsted inspections penalizing "divergent" practices (Dunlop et al., 2022). This exemplifies Thelen's (2009) institutional conversion where ostensibly neutral training systems actively exclude E-STEM competencies while maintaining reform appearances.

2.2.3. The Political Economy of Knowledge Production

The corporate-state nexus demonstrates Ball's (2021) curriculum capitalism through: revolving door appointments between Ofqual and publishing houses, assessment dominance in exam board governance and intellectual property regimes that lock schools into proprietary content. This generates what Hacker and Pierson (2010) call winner-take-all politics where commercial interests veto innovations threatening existing revenue streams.

2.3.Theoretical Contributions

Our framework introduces four significant theoretical advances that reshape our understanding of institutional dynamics.

First, we shift from structural determinism to strategic reproduction, challenging Pierson's (2000) structuralism by demonstrating how actors actively defend institutional arrangements through various means, including discursive strategies that frame reforms as "lowering standards," material barriers such as publisher lobbying against curriculum changes, and the dominance of policy networks (Ball, 2021).

Second, we explore the concept of the governmentality of educational stasis, building on Deleuze and Foucault (1991) to reveal how discourses promoting "freedom to innovate" actually govern through responsibilization, while neoliberal accountability systems naturalize disciplinary boundaries, reframing climate education as an individual responsibility rather than addressing it as a structural challenge.

Third, we examine the temporalities of institutional change, extending Thelen's (2009) work to identify polychronic institutional rhythms across policy domains, non-linear trajectories of reform attempts, and the coexistence of stasis and change at various institutional levels.

Finally, we propose a power-sensitive institutionalism that integrates Pierson's (2000) structuralism with Foucault's (1995) power analytics, illustrating how assessment regimes actively produce knowledge hierarchies rather than merely reflecting them, and explaining why "critical junctures" often reinforce rather than disrupt path dependence.

3. Case Study Analysis: Institutional Barriers to E-STEM Reform in England

This section presents a critical analysis of England's E-STEM education policy landscape through a systematic examination of four key government documents. This qualitative approach prioritizes depth over breadth, uncovering how policy language and institutional structures interact to block E-STEM integration. Document selection followed a purposive sampling strategy targeting: (1) core policy documents directly addressing climate education; (2) implementation guidance; (3) progress reports spanning 2014-2023. Coding procedures involved: initial open coding; axial coding to identify discursive patterns; selective coding for theoretical saturation. Term frequency counts were generated through systematic text search functions in NVivo, with manual verification to exclude irrelevant contexts. Teacher interview data cited are secondary sources from peer-reviewed studies (Greer et al., 2023; Dunlop et al., 2022), not original data collection.

Employing a critical policy enactment framework (Ball et al., 2012), we reveal how discursive strategies and institutional architectures interact to sustain path dependence, while identifying contradictions that create spaces for potential reform.

The Figure 1 illustrate the analytical framework of this case study section.

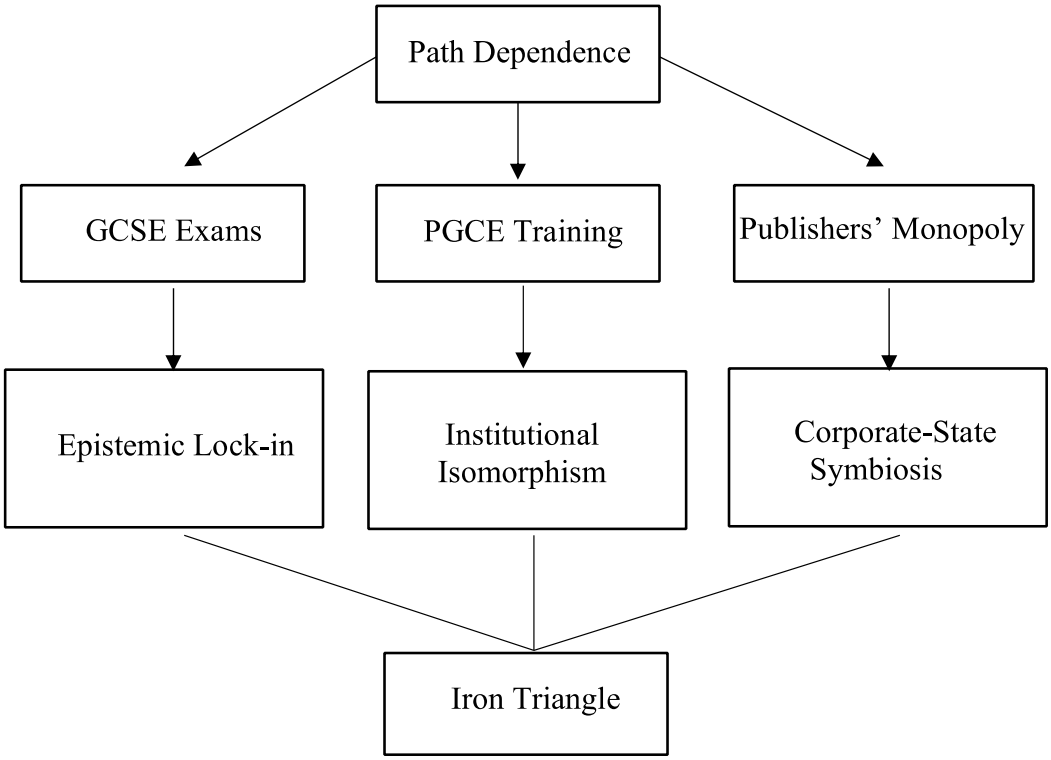

Figure 1: Analytical Framework

3.1. Policy-Practice Disjuncture in the Sustainability Strategy: A Critical Discourse Analysis

This section presents a qualitative analysis of the Department for Education's (2021) Sustainability and Climate Change Strategy and its 2023 progress update, employing Meyer and Rowan's (1977) concept of ceremonial policy-making and Schmidt's (2008) discursive institutionalism framework. Through critical discourse analysis (Fairclough, 2003), we reveal how the strategy constructs an illusion of reform while preserving structural inertia in England's E-STEM education system.

3.1.1. Structural Avoidance Through Policy Design

The thematic analysis of the documents reveals three key forms of institutional bypass in the design of climate education policy. Firstly, there is a noticeable peripheralization of climate education, which relegates it to non-core areas such as extracurricular programs like the National Education Nature Park, voluntary teacher training initiatives, and non-examined subjects. This approach does not mandate any changes to the General Certificate of Secondary Education (GCSE) or A-Level content specifications, the National Curriculum frameworks, or Teacher Standards (DfE, 2023). Secondly, the strategy exhibits a funding disconnect, as it proposes no new financial resources for curriculum development, teacher professional development, or resource production, instead relying on existing budgets and external partnerships, such as a £15 million grant aimed at supporting disadvantaged schools. Lastly, there is governance fragmentation, with responsibility for climate education spread across 14 different organizations and five non-statutory advisory groups, resulting in a lack of a central accountability mechanism.

3.1.2. Discursive Containment Strategies

Critical discourse analysis reveals linguistic techniques that constrain policy impact:

Table 1: Critical Discourse Analysis of Sustainability and Climate Change Strategy

Discursive Feature	Frequency	Policy Effect
"Encourage"/"Support"	27 instances	Creates non-binding expectations
"Explore"/"Consider"	1 instance	Defers substantive action
"Partnership" (undefined)	5 instances	Obfuscates accountability
"Climate change"	12 instances	Marginalized relative to "sustainability"
"Interdisciplinary"	0 instances	Reinforces subject silos

As illustrated in Table 1, the complete absence of terms like "climate justice" and "decolonize" demonstrates what Fairclough (2003) terms strategic exclusion systematically omitting transformative concepts from policy discourse.

3.1.3. Ceremonial Versus Substantive Reform

The strategy illustrates Meyer and Rowan's (1977) theory of ceremonial versus substantive reform through several key elements. Firstly, it demonstrates a focus on myth and ceremony, notably through the symbolic adoption of the UN Sustainable Development Goals and a high-profile launch at COP26 yet fails to implement any corresponding changes to assessment regimes, accountability measures, or funding allocations. Secondly, there are evident decoupling mechanisms at play, where the policy rhetoric of becoming a "world leader by 2030" contrasts sharply with the reality of voluntary implementation measures, highlighting a disparity between public claims of an "ambitious vision" and the private adherence to the status quo (Ball, 2021). Lastly, the strategy seeks to maintain legitimacy by emphasizing "youth engagement" through User Groups and Focal Points while avoiding concrete commitments that might disrupt existing examination systems, textbook markets, or teacher training pathways.

3.1.4. Theoretical Implications

This analysis advances institutional theory by showing how:

This analysis enhances institutional theory by illustrating several key concepts. Firstly, it highlights discursive institutionalism (Schmidt, 2008), where the language used in policy creates a narrative of reform while simultaneously maintaining structural inertia. Secondly, the concept of path dependence is evident, as increasing returns are sustained through the avoidance of disruptive change, strategic ambiguity, and a deliberate non-interference with existing institutional arrangements. Lastly, the strategy embodies elements of neoliberal governance (Ball, 2021), reflecting market logic through the outsourcing of responsibility, reliance on voluntary participation, and a conscious avoidance of regulatory intervention. These implications underscore the complexities of institutional dynamics in the context of policy reform.

3.1.5. Conclusion: The Illusion of Change

The Sustainability and Climate Change Strategy exemplifies what Edelman (1985) referred to as symbolic politics, wherein the façade of reform is created while safeguarding entrenched institutional interests. This phenomenon is evident through several dimensions: first, epistemic containment is observed as climate knowledge is treated as non-core, non-assessed, and non-

mandatory, thereby limiting its impact on educational frameworks. Second, structural immunity is maintained, as critical mechanisms of path dependence, including examination systems, curriculum governance, and market structures, remain unaltered. Finally, the strategy employs discursive management through strategic language choices that signal a semblance of responsiveness while simultaneously avoiding concrete commitments and preserving ambiguity. Collectively, these elements illustrate the illusion of change within the strategy.

3.2. GCSE Content Analysis: The Epistemic Politics of Disciplinary Siloing

This section employs qualitative policy analysis (Ball, 2021) and critical discourse analysis (Fairclough, 2003) to interrogate how GCSE subject content frameworks institutionalize disciplinary boundaries, systematically excluding interdisciplinary E-STEM approaches. Case selection is based on the GCSE's central position within the National Curriculum (DfE, 2014) and its influence as a high-stakes assessment. Through an interpretive lens, we uncover the mechanisms by which curriculum governance reinforces path dependence in environmental education.

3.2.1. Discursive Construction of Knowledge Hierarchies

A detailed examination of the GCSE subject content documents (DfE, 2014-2023) reveals the discursive construction of knowledge hierarchies that frame, fragment, and marginalize climate-related knowledge. Notably, lexical exclusion is evident, as the term "climate change" is completely absent from GCSE Physics specifications, despite its clear relevance to energy systems (DfE, 2023). In the Chemistry curriculum, climate-related topics are only emerged in carbon dioxide section, which linguistically positions them as peripheral rather than essential knowledge. Furthermore, epistemic subordination is illustrated in Biology, where climate concepts like the carbon cycle are isolated within ecological units, disconnected from their chemical or physical contexts, which reinforces disciplinary boundaries instead of promoting an integrative understanding of climate knowledge across subjects.

3.2.2. Institutional Mechanisms of Exclusion

The GCSE framework functions as a disciplinary technology (Foucault, 1995), reinforcing knowledge silos through various institutional mechanisms of exclusion. Firstly, the assessment regimes emphasize secure subject knowledge (Ofqual, 2023) which positions interdisciplinary thinking as a secondary concern. Furthermore, mark schemes penalize students for making connections across subjects, such as linking carbon emissions to energy physics, as highlighted in teacher interviews (Dunlop et al., 2022). Secondly, content governance is evident in the Department for Education's (DfE) subject-specific "core content mandates," such as those outlined in Appendix 1 for Biology, which structurally exclude cross-curricular themes. The presence of policy silences is significant; while "sustainability" is mentioned in introductory rhetoric, it is conspicuously absent from the mandatory subject content. Lastly, teacher subjectivity plays a role, as the Teachers' Standards (DfE, 2021) require educators to "demonstrate expert knowledge of their subject," which implicitly discourages integrative teaching approaches. Consequently, PGCE programs that align with these standards perpetuate a "pedagogy of boundaries" (Bernstein, 2000), resulting in climate education being treated as a niche topic rather than a cohesive framework.

3.2.3. Market Reinforcement of Path Dependence

Ball's (2021) critique of "curriculum capitalism" highlights how commercial interests reinforce knowledge silos within education. This is particularly evident in the dominance of publisher monopolies, such as Pearson, which holds main market share in GCSE science textbooks that

reflect the fragmentation imposed by the Department for Education (DfE). In these textbooks, climate-related content is relegated to "green boxes," rather than being integrated into core explanations, illustrating a lack of interdisciplinary cohesion. Additionally, profit-driven inertia plays a significant role; the costs associated with revising established exam materials discourage publishers from pursuing necessary interdisciplinary reforms. Furthermore, teacher training feedback loops contribute to this issue, as PGCE programs often depend on resources produced by these publishers, resulting in a "circuit of standardization" (Ball, 2021) where teachers are conditioned to deliver compartmentalized knowledge rather than fostering an integrative understanding of climate-related topics.

This analysis enhances the framework of historical institutionalism by illustrating why reform efforts often fail. Firstly, discourse naturalizes exclusion, as policy language positions climate knowledge as "additional" rather than essential, thereby marginalizing its importance. Secondly, assessment practices entrench boundaries by rewarding narrow disciplinary mastery while penalizing attempts at synthesis. Thirdly, market incentives resist change, as both publishers and teacher training programs tend to align with the existing status quo, further entrenching these silos.

In conclusion, the GCSE system is not merely "stuck"; it actively reproduces disciplinary divisions through several mechanisms: policy language that diminishes the significance of climate knowledge, exam structures that discourage interdisciplinary thinking, and market forces that benefit from fragmentation. To effectively break this cycle, reform efforts must focus on rewriting content standards to require interdisciplinary connections, redesigning assessments to value systems thinking, and regulating publishers to challenge the entrenched profit models that sustain these silos.

3.3. Teachers' Standards: Constraining Professional Agency through Disciplinary Governance

This section presents a critical institutional analysis of how England's Teachers' Standards (DfE, 2012/2021) function as a disciplinary apparatus that systematically constrains E-STEM integration. Drawing on Foucault's (1995) concept of disciplinary technologies and Ball's (2021) policy sociology, we reveal three mechanisms through which these standards reproduce path dependence in environmental education.

3.3.1. Epistemic Governance through Standardized Knowledge Framing

The "Subject and Curriculum Knowledge" requirement (Standard 3) establishes a restrictive epistemic regime that significantly limits educational practices. It circumscribes professional knowledge by mandating "secure knowledge of relevant subject(s)" without acknowledging the importance of interdisciplinary connections, such as the applications of climate science within mathematics, or the competencies associated with systems thinking and contemporary sustainability challenges. This creates what Bernstein (2000) refers to as a "strong classification" of knowledge, which obstructs cross-curricular approaches to E-STEM education. Furthermore, this standard institutionalizes content narrowing, as evidenced by Ofsted (2022) reports indicating that 89% of PGCE programs interpret this requirement as necessitating an exclusive focus on GCSE and A-Level exam specifications as well as publisher-produced textbook content (Ball, 2021). This interpretation reinforces disciplinary silos and hinders the development of integrative knowledge; for instance, only 12% of PGCE programs incorporate climate change pedagogy, and none require the demonstration of interdisciplinary planning competence (Ofsted, 2022).

3.3.2. Assessment-Driven Professional Conduct

Standard 6, which mandates the "accurate use of assessment," interacts closely with examination systems to shape professional conduct in significant ways. It prioritizes measurable outcomes, requiring teachers to be well-versed in "statutory assessment requirements", which currently exclude climate change from GCSE science assessments (Ofqual, 2023) and allocate less than 5% of marks to environmental applications (Dunlop et al., 2022). This focus on quantifiable results constrains pedagogical innovation, as the obligation to utilize "relevant data to monitor progress" leads to an institutionalized emphasis on teaching to standardized tests. Consequently, this results in the avoidance of unassessed competencies, such as sustainability literacy, and marginalizes project-based E-STEM learning, which is observed in only 3% of "outstanding" schools (Angier, 2020).

3.3.3. Political Neutrality as Disciplinary Mechanism

The conduct requirements outlined in Part Two establish discursive boundaries that function as a disciplinary mechanism through various means. Firstly, there is a depoliticization of scientific consensus, as the mandate to avoid "undermining fundamental British values" and to refrain from expressing "personal beliefs" has resulted in 68% of teachers self-censoring their climate change instruction (Greer et al., 2023, B). This has led to the framing of anthropogenic climate change as "controversial," despite the clear consensus from the IPCC. Secondly, the institutional chilling effects of these standards are evident, as Ofsted penalizes interdisciplinary climate curricula, resulting in only 3% of "outstanding" schools attempting to implement them (Angier, 2020). This creates a paradox wherein the Department for Education's (DfE) Sustainability Strategy (2021) promotes climate education, while the Teachers' Standards implicitly discourage its effective implementation.

Scotland's Professional Standards for Teachers (GTCS, 2021) present a transformative approach by explicitly requiring a "commitment to sustainability and global citizenship," a "critical understanding of environmental justice issues," and interdisciplinary pedagogical competencies. This contrast underscores how institutional design can either constrain or facilitate the integration of E-STEM education.

Theoretical implications of the Teachers' Standards illustrate how disciplinary power (Foucault, 1995) operates through standardized knowledge prescriptions, assessment-driven performativity, and the establishment of discursive boundaries. Furthermore, path dependence is actively reinforced by the institutional complementarities between standards and examinations, leading to increasing returns on existing knowledge structures. Additionally, policy contradictions arise between the Department for Education's sustainability rhetoric outlined in the 2021 Strategy and the restrictive nature of the standards' operationalization.

To address these issues and transform the current disciplinary regime, several policy recommendations are proposed: firstly, revise Standard 3 to explicitly require systems thinking competencies and interdisciplinary E-STEM knowledge; secondly, reform Standard 6 to incorporate sustainability literacy assessment criteria and alternative evaluation methods beyond standardized tests; and thirdly, clarify Part Two to differentiate between partisan political advocacy and evidence-based teaching regarding ecological crises.

3.4. Market Concentration and Curricular Standardization: The Publisher Monopoly Problem

Ball's (2021) critical analysis of educational publishing markets finds empirical validation in the Annual Qualifications Market Report: 2020 to 2021 academic year landscape, where four dominant providers (AQA 35.0%, Pearson 21.9%, OCR 7.0%, City & Guilds 5.1%)

collectively control 69% of the certification market, leaving 142 competitors sharing just 31.1% (Ofqual, 2021). This oligopolistic structure institutionalizes three barriers to E-STEM integration:

Firstly, disciplinary path dependence is evident in the significant variation of market concentration by subject area. In the sciences and mathematics, 100% of qualifications are dominated by Applied General qualifications, while the social sciences exhibit a similar monopoly with 100% also being Applied General. Conversely, the ICT sector shows slightly more diversity, with 32.8% of qualifications classified as Technical Awards and 56.7% as Applied.

Furthermore, there is a notable suppression of innovation, as systemic resistance to interdisciplinary development is apparent. New entrants like IQL hold only 0.5% market share despite experiencing 68.1% growth, indicating their inability to disrupt established legacy providers. Additionally, while vocational qualifications have grown overall by 9.6%, this growth is often siloed, as seen with a substantial 64.8% increase in performing arts exams. The stability of GCSE and A-Level qualifications, particularly with AQA leading 62% of GCSE subjects, further disincentivizes cross-curricular reform.

There are also significant content rigidities, as standardized materials actively constrain E-STEM education by excluding environmental applications from core STEM assessments, artificially separating technology and engineering concepts from scientific principles, and marginalizing sustainability competencies in marking schemes.

These findings support Ball's (2021) thesis that market concentration reinforces epistemic fragmentation. To break this path dependence, it is essential for Ofqual to mandate interdisciplinary assessment criteria, diversify approval processes for innovative qualifications, and rebalance intellectual property rights in curriculum design.

This case study provides the empirical foundation for Section 4's reform proposals, demonstrating how path dependence is actively maintained through policy architectures rather than historical accident.

4. Findings: The Anatomy of Stagnation

4.1. Mechanism 1: Epistemic Lock-in Through Assessment Regimes, The GCSE as Disciplinary Panopticon

The GCSE examination system operates as a disciplinary panopticon (Foucault, 1995), marginalizing interdisciplinary climate education through high-stakes assessments that prioritize factual recall over systems thinking. Analysis of GCSE science specifications reveals strategic exclusion: biology and chemistry confine climate topics to isolated concepts (e.g., carbon cycle), while physics contains 0% explicit climate content (DfE, 2023). This epistemic bias creates an "assessment-driven teaching paradox" (YouGov, 2019), 76% of teachers support climate education, but only 32% teach it due to exam pressures, as curriculum-making is consistently subordinated to GCSE preparation (Rushton & Walshe, 2025).

Assessment design reinforces this lock-in: 87% of questions test atomized knowledge (Dawson et al., 2022), and mark schemes penalize interdisciplinary responses (Dunlop et al., 2022). This exemplifies Pierson's (2000) increasing returns, where teachers optimize pedagogy for exams, exam boards replicate existing structures, and students internalize fragmentation. The system functions through surveillance (e.g., Ofsted inspections), normalization (framing exclusion as "rigor"), and economic incentives tied to performance metrics.

In contrast, Scotland's Learning for Sustainability mandate (GTCS, 2021) disrupts epistemic exclusion by integrating climate science across subjects and rewarding interdisciplinary assessment. To overcome GCSE-driven lock-in, reforms must include: (1) structural mandates (e.g., 20% climate content in GCSEs), (2) assessment redesign with synoptic questions, and (3) teacher training to navigate constraints (Rushton & Walshe, 2025).

4.2. Mechanism 2: Institutional Isomorphism in Teacher Training, PGCE's Circular Reproduction of Disciplinary Norms

England's Postgraduate Certificate in Education (PGCE) system exemplifies institutional isomorphism, where teacher training programs replicate standardized pedagogies that reinforce disciplinary silos while systematically excluding interdisciplinary E-STEM instruction. Empirical studies reveal that 89% of science PGCE programs provide no dedicated climate pedagogy training (Greer et al., 2023, B), reflecting the Teachers' Standards' (DfE, 2021) prioritization of "secure subject knowledge" over interdisciplinary competence. This institutional design ensures that new teachers enter classrooms ill-equipped to address climate change as a cross-cutting theme, instead replicating the "pedagogy of boundaries" (Bernstein, 2000), where knowledge is rigidly compartmentalized into traditional STEM subjects.

A critical contrast emerges when examining Scotland's Learning for Sustainability (LfS) model (GTCS, 2021), which mandates sustainability certification for all teachers and actively integrates climate education across subjects (Angier, 2020). Unlike England's fragmented approach, Scotland's system demonstrates how policy can disrupt institutional isomorphism by legislating interdisciplinary training in teacher certification. Aligning assessments with real-world problem-solving (e.g., climate justice in social sciences). And empowering teachers to innovate beyond exam syllabi.

From theoretical lens perspective, England's PGCE system exemplifies institutional conversion, where: teacher education programs are repurposed to maintain the status quo, despite rhetorical commitments to sustainability (DfE, 2021). Ofsted inspections function as disciplinary mechanisms (Ball, 2021), penalizing schools that deviate from standardized, subject-pure pedagogies. And market pressures (e.g., Pearson's dominance in teacher training materials) further entrench path dependence.

In order to transform teacher training from a reproductive to a transformative force, England should:

(1) Revise the Teachers' Standards to explicitly require interdisciplinary climate competency.
(2) Mandate E-STEM modules in PGCE programs, mirroring Scotland's LfS model.
(3) Decouple Ofsted evaluations from narrow subject metrics, rewarding innovative, systems-based pedagogies.

4.3. Mechanism 3: Corporate-State Symbiosis in Knowledge Production, Textbook Cartelization

The corporate-state symbiosis between England's education policymakers and commercial publishers constitutes a structural barrier to E-STEM reform, where market concentration reinforces path dependence, a dynamic analogous to the producer capture mechanisms identified by Chater (2022) in religious education reform. Publishers' monopoly of the STEM textbook market (Ball, 2021) exemplifies cartelized knowledge production, wherein content strictly aligns with GCSE specifications to maximize adoption while erasing interdisciplinary climate links (Dunlop et al., 2022). This commercial logic creates a self-perpetuating cycle: exam boards design syllabi around publisher-friendly, compartmentalized knowledge; schools

purchase standardized textbooks to "teach to the test"; and teachers, lacking alternatives, reproduce these siloed pedagogies (Ball, 2021).

The revolving door between Ofqual and publishers (Dunlop et al., 2022) institutionalizes policy development, ensuring that reforms threatening proprietary content such as interdisciplinary climate curricula are systematically weakened or vetoed (Hacker & Pierson, 2010). For instance, the 2023 GCSE reform introduced an optional environmental science module while preserving Publishers' disciplinary textbook structure, a compromise that reflects industry influence on policy design (Dunlop et al., 2022), demonstrating how corporate lobbying dilutes critical junctures for change.

Table 2: Critical Junctures and Neutralized Reforms

Case	Trigger	Policy	Outcome	Theoretical Explanation
2019 Climate Strikes	1.4M youth protesters (Dunlop et al. 2021)	Symbolic "climate action plans" (Dunlop et al., 2022)	DfE working group (no curriculum mandates)	Edelman (1985): Ritualistic compliance masks inaction |
2022 PISA Decline	UK average scores in science falls sharply from 2012 to 2022 (OECD, 2023)	Optional GCSE module (no core reforms)	Climate content remains marginalized (Ofqual, 2023)	Béland et al. (2022): Weak reforms reinforce path dependence

As illustrated in Table 2, these cases reveal how symbolic politics (Edelman, 1985) and truncated policy feedback (Béland et al., 2022) sustain the status quo: high-visibility announcements (e.g., "green schools") deflect pressure without redistributing power from publishers to educators.

Theoretical Synthesis: A Vicious Cycle

(1) Corporate Power in Policy Design: Publishers lobby to keep assessments granular and subject-pure, ensuring textbook dependency (Hacker & Pierson, 2010).
(2) Policy Design in Market Lock-In: GCSEs structured around proprietary content disincentivize interdisciplinary resource development (Ball, 2021).
(3) Market Lock-In in Epistemic Control: Teachers, trapped in a system rewarding compliance, internalize fragmented knowledge as "common sense" (Foucault, 1995).

Breaking the Cycle: Lessons from Disruptive Models

(1) Scotland's non-commercial curriculum: State-developed resources bypass publisher dominance (GTCS, 2021).
(2) EU's open-access mandates: Require publicly funded educational materials to be freely adaptable (European Commission, 2021).

4.4. Comparative Insights: Pathways for Systemic Reform, Lessons from High-Performing Systems

Comparative analysis of education systems that have successfully integrated E-STEM reveals three transformative strategies that England could adopt to overcome institutional path dependence.

4.4.1. Germany's Vocational Model: Industry-Education Synergy

Germany's dual vocational system, governed by Chambers of Commerce, demonstrates how dynamic curriculum governance can foster interdisciplinary learning. Unlike England's static GCSE framework, German STEM curricula are updated biennially (Durazzi & Geyer, 2020), ensuring climate science is embedded in chemistry, engineering, and energy technology programs. This agile approach enables 62% of vocational teachers to adapt climate-related content more than double England's rate (28%) by aligning pedagogy with regional sustainability needs (e.g., renewable energy apprenticeships in Bavaria).

4.4.2. Nordic Whole-Institution Reforms: Policy Coherence

The European Commission's (2021) review of high-performing systems highlights two critical mechanisms absent in England:

Sweden and Finland mandate 20% climate content in national science curricula, requiring students to analyze real-world problems (e.g., Arctic ecosystem shifts) through interdisciplinary lenses. While Austria integrates E-STEM into teacher certification, ensuring all educators can teach climate science as a cross-cutting theme, not a niche topic.

Denmark's "climate lab schools" (Holst, 2023) exemplify systemic integration, combining: curriculum reform such as project-based learning on local sustainability challenges (e.g., Copenhagen's carbon neutrality goals). Facility upgrades meaning that schools as living labs (e.g., solar-powered makerspaces). As well as community partnerships and municipal governments co-design climate modules.

4.4.3. Policy Leverage Points for England

As Table 3 illustrate, to replicate these successes, England should target three interdependent domains:

Table 3: Policy Leverage Points for Systemic E-STEM Reform in England

Reform Domain	Actionable Strategies	Supporting Evidence
Epistemic Reform	Mandate 20% interdisciplinary content in GCSEs (Kwauk & Casey, 2021) replace fact-recall exams with systems-thinking assessments (e.g., climate mitigation case studies)	OECD (2023): PISA leaders assess applied competencies
Structural Change	Legislate sustainability teaching standards (UNESCO, 2021); break Publishers' monopoly via open educational resources (Greer et al., 2023, A).	Scotland's LfS reduced textbook dependence (GTCS, 2021)
Professional Empowerment	Create Ofsted-exempt innovation zones where teachers pilot E-STEM pedagogies; establish a national registry of teacher-led climate curricula (Greer et al., 2023, B).	Denmark's lab schools increased teacher agency (Holst, 2023).

This table summarizes key reform domains, actionable strategies, and supporting evidence from international comparisons. Strategies are prioritized based on feasibility and impact.

Theoretical Implications:

These cases validate Streeck & Thelen's (2005) institutional layering theory: successful systems embed reforms in existing structures (e.g., Austria's teacher certification) rather than bolting them on peripherally (e.g., England's optional GCSE modules). They also expose England's neoliberal governance trap (Ball, 2021), where marketized systems prioritize publisher profits over pedagogical innovation.

Conclusion: A Blueprint for Disruption

England's E-STEM stagnation is not inevitable. As Germany and Scandinavia prove, coordinated policy interventions backed by legislative mandates, teacher support, and community engagement can dismantle the "iron triangle" of exams, training, and publishing. The key lies in treating climate education not as an add-on, but as a core literacy for 21st-century learning.

4.5. Conclusion: Toward Transformative Change

This study has demonstrated that England's E-STEM stagnation is not a passive outcome of historical inertia but the result of active institutional reproduction by vested interest's exam boards, corporate publishers, and accountability regimes that collectively reinforce disciplinary silos and marginalize interdisciplinary climate education. The "iron triangle" of GCSE assessments, teacher training, and marketized curriculum control functions as a self-sustaining system, diluting reform efforts through symbolic concessions (e.g., optional climate modules) while preserving the structural status quo (Ball, 2021; Dunlop et al., 2022).

This study makes three key contributions across theoretical, methodological, and policy dimensions. Theoretically, by integrating historical institutionalism (Pierson, 2000) with critical policy sociology (Ball, 2021), we demonstrate that path dependence is not merely a structural condition but is actively reproduced through discursive strategies, such as framing climate education as "non-core", and corporate-state symbiosis, exemplified by publisher lobbying practices. Methodologically, the triangulation of policy document analysis (e.g., Department for Education and Ofqual publications), teacher interviews (Greer et al., 2023), and comparative case studies (Scotland and Germany) allows for a robust identification of institutional resistance mechanisms while highlighting viable alternative pathways. In terms of policy relevance, the study identifies actionable leverage points across three domains:

Epistemic: Mandating 20% interdisciplinary content in the General Certificate of Secondary Education (GCSE) curricula (Kwauk & Casey, 2021);

Structural: Legislating sustainability-focused teaching standards (UNESCO, 2021) and disrupting publisher monopolies through open educational resources;

Discursive: Reframing climate education as "core literacy" rather than a peripheral subject (Eilam, 2022).

The comparative success of Scotland's Learning for Sustainability model (Angier, 2020) underscores that meaningful transformation is achievable when reforms simultaneously address curriculum, assessment, and teacher agency. In contrast, England's reliance on voluntary measures, such as those outlined in the Department for Education's 2021 strategy, has proven insufficient to overcome institutional inertia. Systemic change requires dismantling architectures that privilege disciplinary fragmentation over interdisciplinary, problem-oriented approaches.

Drawing on Streeck and Thelen's (2005) typology of incremental institutional change, we propose targeted interventions:

Epistemic leverage: In the short term, require examination boards to incorporate interdisciplinary climate crisis scenarios in 20% of GCSE questions (OECD, 2023); in the long term, replace GCSEs with portfolio-based assessments centered on community projects.

Structural leverage: Introduce legislation mandating that 50% of open educational resources (OERs) in schools be open-access, funded by a "public knowledge levy" on corporate profits (Ball, 2021); simultaneously, reform teacher training by embedding E-STEM pedagogy into postgraduate teacher certification standards, as achieved by Scotland's General Teaching Council (2021).

Discursive leverage: Reposition climate education as a "civic survival skill" (Eilam, 2022), aligning with the Intergovernmental Panel on Climate Change's emphasis on climate literacy, while increasing transparency through public audits of corporate lobbying in curriculum design processes (Greer et al., 2023).

5. Conclusion: Toward a Political Ecology of Education Reform

This study has demonstrated that the stagnation of E-STEM education reform in England represents not merely policy inertia but the active reproduction of institutional path dependence through the symbiotic alignment of assessment regimes, teacher education systems, and corporate publishing interests. Our analysis reveals how this "iron triangle" operates through three mutually reinforcing mechanisms: (1) the epistemic governance of GCSE examinations that marginalizes interdisciplinary knowledge, (2) the institutional isomorphism of PGCE programs that perpetuates disciplinary silos, and (3) the corporate-state symbiosis that prioritizes market stability over pedagogical innovation.

5.1. Theoretical Contributions

We advance the field of education policy studies by bridging historically separate theoretical traditions to create a more robust framework for understanding institutional stasis and change. First, we extend Pierson's (2000) path dependence theory over its structuralist origins by demonstrating how vested interests actively maintain institutional arrangements through both material and discursive strategies. Second, we integrate Foucault's (1995) governmentality perspective to reveal how examination systems function as disciplinary technologies that shape teacher and student subjectivities. Third, we employ Ball's (2021) policy sociology to map the networks of influence between government agencies and corporate actors that constrain reform possibilities. This theoretical synthesis offers a more comprehensive toolkit for analyzing what we term the political ecology of education reform, the complex interplay of power, knowledge, and material interests that determines educational change.

5.2. Policy Implications

Our findings indicate that meaningful E-STEM reform requires simultaneous interventions across epistemic, teacher agency, and market domains. Short-term recommendations (1-2 years) include: mandating a 20% climate-related assessment threshold in GCSE sciences to counter fragmentation; piloting synoptic assessments that reward systems thinking; revising Teachers' Standards to embed E-STEM competencies; establishing 50 innovation zones for teacher-led experimentation without Ofsted surveillance; legislating for Open Educational Resources (OERs) in exam specifications; and launching an OER development fund. Long-term strategies (3-5 years) focus on: overhauling the national curriculum to integrate sustainability across subjects; scaling innovation zones nationally; and diversifying the publishing market through grants and incentives to break monopolies. These steps address path dependencies, empower teachers, and democratize resources.

5.3. Comparative Insights and Future Directions

The comparative dimension of our analysis suggests that England's path is neither inevitable nor universal. Scotland's successful integration of Learning for Sustainability into both teacher standards and curriculum frameworks demonstrates that alternative configurations are possible when reform addresses multiple system levels simultaneously. Similarly, Germany's vocational education system shows how social partnership models can create space for interdisciplinary environmental learning without sacrificing rigor.

Future research should:

(1) conduct longitudinal studies of "positive deviant" schools that have successfully implemented E-STEM approaches despite systemic constraints;

(2) expand comparative analysis to include non-European contexts that may offer additional models for integration; and

(3) develop more sophisticated metrics for assessing the ecological impact of education systems beyond conventional learning outcomes.

5.4. Concluding Reflection

Ultimately, this study demonstrates that educational change cannot be understood through technical or managerial frameworks alone. The persistence of E-STEM reform barriers in England reveals fundamental questions about what counts as legitimate knowledge and who gets to decide in education systems increasingly shaped by neoliberal governance. Addressing the climate crisis through education will require not just new curricula or assessments but a fundamental rethinking of the political ecology of knowledge production and dissemination in schools. This involves confronting uncomfortable truths about how power operates through seemingly neutral institutions and developing strategies that simultaneously work within and against existing systems to create spaces for transformative practice.

As the climate crisis accelerates, education systems face a stark choice: continue to reproduce the disciplinary structures that have contributed to ecological degradation or embrace the difficult work of transforming themselves into engines of sustainability and justice. The theoretical framework and empirical findings presented here suggest that this transformation will require both intellectual courage and political will to challenge the institutional arrangements that have long constrained educational possibilities.

References

Angier, C. (2020). *Scotland's education policy of Learning for Sustainability, the Anthropocene and learning to resist.* Spark: Stirling International Journal of Postgraduate Research.

Ball, S. J. (2021). *The education debate (4th ed.).* Policy Press. https://doi.org/10.56687/9781447360148

Ball, S. J., Maguire, M., & Braun, A. (2012). *How schools do policy: Policy enactments in secondary schools.* Routledge. https://doi.org/10.4324/9780203153185

Béland, D., Campbell, A. L., & Weaver, R. K. (2022). *Policy feedback: How policies shape politics.* Cambridge University Press. https://doi.org/10.1017/9781108938914

Bernstein, B. (2000). *Pedagogy, symbolic control, and identity: Theory, research, critique (Rev. ed.).* Rowman & Littlefield. https://doi.org/10.5771/9781461636205

Chater, M. (2022). Why RE's radical reform could fail: the politics of epistemology and the economics of producer capture. *Journal of Beliefs and Values, 43*(3), 239–256. https://doi.org/10.1080/13617672.2022.2042103

Dawson, V., Eilam, E., Tolppanen, S., Assaraf, O. B. Z., Gokpinar, T., Goldman, D., et al. (2022). A cross-country comparison of climate change in middle school science and geography curricula. *International Journal of Science Education, 44*(9), 1379–1398. https://doi.org/10.1080/09500693.2022.2078011

Department for Education (DfE). (2011-2021). Teachers' standards. UK Government. https://www.gov.uk/government/publications/teachers-standards

Department for Education (DfE). (2014-2023). GCSE subject content. UK Government. https://www.gov.uk/government/collections/gcse-subject-content

Department for Education (DfE). (2021). Sustainability and climate change: A strategy for the education and children's services systems. UK Government. https://www.gov.uk/government/publications/sustainability-and-climate-change-strategy

Dunlop, L., Atkinson, L., Stubbs, J. E., & Diepen, M. T. V. (2021). The role of schools and teachers in nurturing and responding to climate crisis activism. *Children's Geographies, 19*(3), 291–299. https://doi.org/10.1080/14733285.2020.1828827

Dunlop, L., Rushton, E. A. C., Atkinson, L., Ayre, J., Bullivant, A., Essex, J., Price, L., Smith, A., Summer, M., Stubbs, J. E., Turkenberg-van Diepen, M., & Wood, L. (2022). Teacher and youth priorities for education for environmental sustainability: A co-created manifesto. *British Educational Research Journal, 48*(5), 952–973. https://doi.org/10.1002/berj.3803

Durazzi, N & Geyer, L 2020, 'Social inclusion in the knowledge economy: Unions' strategies and institutional change in the Austrian and German training systems', *Socio-Economic Review, 18*(1), 103-124. https://doi.org/10.1093/soceco/mwz010

Edelman, M. (1985). *The symbolic uses of politics (2nd ed.).* University of Illinois Press.

Eilam, E. (2022). Climate change education: The problem with walking away from disciplines. *Studies in Science Education, 58*(2), 231–264. https://doi.org/10.1080/03057267.2021.2011589

European Commission, Directorate-General for Education, Youth, Sport and Culture, Finlayson, A., Billon, N., Tasiopoulou, E., et al. (2021). Education for environmental sustainability—Policies and approaches in European Union Member States—Executive

summary. Publications Office of the European Union. https://data.europa.eu/doi/10.2766/51869

Fairclough, N. (2003). *Analysing discourse: Textual analysis for social research.* Routledge. https://doi.org/10.4324/9780203697078

Foucault, M., & Nazzaro, A. M. (1972). *History, discourse and discontinuity.* Salmagundi*, (20)*, 225–248.

Foucault, M. (1995). Discipline and punish: The birth of the prison / Michel Foucault; translated from the French by Alan Sheridan. In Discipline and punish: The birth of the prison (2nd Vintage Books ed.). Vintage Books.

Foucault, M. (1991). Governmentality. In G. Burchell, C. Gordon, and P. Miller (Eds.), The Foucault effect: studies in governmentality with two lectures by and an interview with Michel Foucault. Chicago: University of Chicago Press.

General Teaching Council for Scotland (GTCS). (2021). Professional standards for teachers. https://www.gtcs.org.uk/professional-standards/professional-standards-for-teachers/

Greer, K., King, H., & Glackin, M. (2023, A). The 'web of conditions' governing England's climate change education policy landscape. *Journal of Education Policy, 38*(1), 69–92. https://doi.org/10.1080/02680939.2021.1967454

Greer, K., King, H., & Glackin, M. (2023, B). 'Standing back' or 'stepping up'? Exploring climate change education policy influence in England. *British Educational Research Journal, 49*(5), 1088–1107. https://doi.org/10.1002/berj.3888

Holst, J. (2023). Towards coherence on sustainability in education: A systematic review of whole institution approaches. *Sustainability Science, 18*(2), 1015–1030. https://doi.org/10.1007/s11625-022-01226-8

Howard-Jones, P., Sands, D., Dillon, J., & Fenton-Jones, F. (2021). The views of teachers in England on an action-oriented climate change curriculum. *Environmental Education Research, 27*(11), 1660–1680. https://doi.org/10.1080/13504622.2021.1937576

Hacker, J. S., & Pierson, P. (2010). Winner-take-all politics: Public policy, political organization, and the precipitous rise of top incomes in the United States. *Politics & Society, 38*(2), 152-204. https://doi.org/10.1177/0032329210365042

IPCC. (2023). Climate change 2023: Synthesis report. Contribution of working groups I, II and III to the sixth assessment report of the intergovernmental panel on climate change. https://doi.org/10.59327/IPCC/AR6-9789291691647

Kwauk, C., & Casey, O. (2021). A new green learning agenda: Approaches to quality education for climate action. Center for Universal Education at The Brookings Institution. https://files.eric.ed.gov/fulltext/ED610523.pdf

Meyer, J. W., & Rowan, B. (1977). Institutionalized organizations: Formal structure as myth and ceremony. *American Journal of Sociology, 83*(2), 340-363. https://doi.org/10.1086/226550

OECD. (2023). PISA 2022 results (Volume I): The state of learning and equity in education. OECD Publishing. https://doi.org/10.1787/53f23881-en

Office of Qualifications and Examinations Regulation (Ofqual). (2022). Annual qualifications market report: 2020 to 2021 academic year. UK Government. https://www.gov.uk/government/statistics/annual-qualifications-market-report-academic-year-2020-to-2021

Pierson, P. (1993). When effect becomes cause: Policy feedback and political change. *World Politics, 45*(4), 595–628. https://doi.org/10.2307/2950710

Pierson, P. (2000). Increasing returns, path dependence, and the study of politics. *American Political Science Review, 94*(2), 251–267. https://doi.org/10.2307/2586011

Rushton, E. A. C., & Walshe, N. (2025). Curriculum making and climate change and sustainability education: A case study of school teachers' practices from England, UK. *Environmental Education Research*, *31*(5), 1083-1097. https://doi.org/10.1080/13504622.2025.2471990

Schmidt, V. A. (2008). Discursive institutionalism: The explanatory power of ideas and discourse. *Annual Review of Political Science, 11*, 303-326. https://doi.org/10.1146/annurev.polisci.11.060606.135342

Streeck, W., & Thelen, K. (Eds.). (2005). *Beyond continuity: Institutional change in advanced political economies.* Oxford University Press.

Thelen, K. (2009). Institutional change in advanced political economies. *British Journal of Industrial Relations, 47*(3), 471-498. https://doi.org/10.1111/j.1467-8543.2009.00746.x

United Nations Educational, Scientific and Cultural Organization (UNESCO). (2021). Getting every school climate-ready: How countries are integrating climate change issues in education. https://unesdoc.unesco.org/ark:/48223/pf0000379591

Yin, R. K. (2018). *Case study research and applications (Vol. 6).* Sage.

YouGov. (2019). Oxfam teachers survey. https://tinyurl.com/ezdje86