Flood Risk Education in the Climate Emergency: Teacher Preparation, Textbook Ecologies, and Place-Based Pathways to Socio-Territorial Resilience

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Abstract

Flooding is intensifying as a social–environmental risk in many regions due to changing hazard regimes, rapid land-use transformation, and persistent exposure and vulnerability. Education is frequently invoked as a scalable strategy for strengthening resilience; however, recent evidence shows a recurrent implementation gap: flood risk is curricularized, yet the knowledge, pedagogies, and resources required for high-quality instruction remain unevenly developed. Building on prior scholarship and integrating recent studies (2021–2025), this review synthesizes research on (i) what students and teachers know about floods and related climate hazards, (ii) how flood risk is represented through textbooks and media-influenced information channels, and (iii) which pedagogical approaches appear most promising for improving risk understanding, perception, and preparedness. Across contexts, learners often report limited or fragmented training, with substantial dependence on digital media and traditional textbooks, both of which can omit key components of risk (exposure, vulnerability) and sometimes amplify catastrophism. Empirical interventions role-play, experience-based learning, fieldwork, authentic projects, and GIS-supported place interpretation consistently improve selected outcomes (especially knowledge and risk perception), though effects on preparedness intentions are less stable. For teacher education, the central challenge is not only "more content," but disciplined integration of geographic risk reasoning, critical media/textbook literacy, and locally grounded didactic design. A research and practice agenda is proposed to accelerate socio-territorial resilience through coherent curriculum–teacher–community alignment.

Keyword: *Flood Risk Education; Disaster Risk Reduction; Climate Change Education; Geography Education; Teacher Training*

1. INTRODUCTION

Floods remain among the most consequential hazards for human security, educational continuity, and territorial development, with impacts that are simultaneously physical (hydrometeorological extremes) and socio-spatial (where, how, and why people and assets are positioned in harm's way). In school systems, floods are often framed as "natural" events, yet contemporary risk scholarship emphasizes that disaster outcomes emerge from the interaction among hazard, exposure, and vulnerability an interaction increasingly shaped by climate change, rapid urbanization, and governance choices. Educational responses therefore face a dual task: conveying the physical geography of floods while also developing civic understanding of the human drivers of risk (e.g., land-use decisions, unequal vulnerability, and preparedness cultures) (Morote-Seguido & Hernández-Hernández, 2021; Morote-Seguido et al., 2023; Sánchez-Almodóvar et al., 2023).

At the same time, education is regularly positioned as a mechanism for resilience-building: it can cultivate awareness, strengthen preparedness norms, and support intergenerational transfer of risk knowledge. Yet the empirical record is more nuanced. Multiple studies show that learners and even future teachers often report limited training and uncertain conceptual understanding, while relying heavily on digital media and textbooks as information sources (Morote-Seguido & Hernández-Hernández, 2021; Morote-Seguido & Hernández-Hernández, 2022; Morote et al., 2021; Mitchell, 2023). This pattern raises a critical question for a research-led review: if education is to reduce flood risk, what exactly must be taught, how should it be taught, and what conditions enable teachers to teach it well?

This article reviews the literature provided in the two supplied files, updating and deepening earlier syntheses with recent work on student knowledge and perceptions of floods and climate hazards, textbook representations, teacher training gaps, and didactic innovations such as role-play, authentic

learning projects, and GIS-based resources (Bosschaart et al., 2016; McEwen et al., 2014; Williams et al., 2017; Morote-Seguido et al., 2024; Morote-Seguido et al., 2024; Gómez-Trigueros & Morote-Seguido, 2025). The core argument advanced here is that flood risk education succeeds when it (i) centers geographic risk reasoning (hazard–exposure–vulnerability), (ii) adopts place-based, experience-rich pedagogies that connect lived territory to scientific explanation, and (iii) equips teachers with critical literacy to navigate textbook and media "risk ecologies" that shape student understanding.

2. Review scope and synthesis approach

This review draws exclusively on the studies contained in the provided literature scopus. The synthesis is organized around four interlinked strands that recur across the included works: (1) learner knowledge, perception, and preparedness; (2) pedagogical designs and learning outcomes; (3) teacher preparation and professional capacity; and (4) instructional materials, especially textbooks and media-linked information channels. The review is integrative rather than meta-analytic, because the included studies vary substantially in design (surveys, quasi-experiments, program evaluations, textbook/image analyses, and didactic proposals), target populations (primary students, secondary students, pre-service teachers, in-service teachers), and outcome measures (knowledge, risk perception, motivation, attitudes, preparedness intentions, or didactic creativity) (Bosschaart et al., 2016; Ahn et al., 2020; Intaramuean et al., 2024; Morote-Seguido & Hernández-Hernández, 2021; Morote-Seguido et al., 2023; Hiromi et al., 2021).

Because the user requested citation integrity and a high density of in-text citations, claims are anchored to specific studies from the supplied corpus, emphasizing the most recent contributions when possible (2022–2025) while retaining foundational empirical work that shapes the field's main mechanisms and debates (McEwen et al., 2014; Bosschaart et al., 2016; Williams et al., 2017; Morote-Seguido & Olcina-Cantos, 2021; Mitchell, 2023; Gómez-Trigueros & Morote-Seguido, 2025). The goal is not only to summarize results, but to interpret their implications for curriculum design, teacher education, and resilience outcomes.

3. Conceptual foundations: from "floods as events" to "risk as socio-territorial process"

3.1 Risk reasoning in geographic education

A persistent tension across the corpus is the tendency of instructional materials and classroom explanations to treat floods primarily as meteorological or hydrological phenomena events that "happen" rather than as risks that are produced through the coupling of environmental dynamics with social decisions. This is made explicit in textbook analyses showing that flood content often emphasizes physical causality and under-specifies the human drivers of exposure and vulnerability (Morote-Seguido et al., 2023). When learners are not guided to integrate these components, they may acquire vocabulary about floods without developing the analytic capacity to interpret why impacts differ across territories and social groups (Morote-Seguido et al., 2024; Mudavanhu, 2015; Intaramuean et al., 2024).

Geography education is repeatedly advanced as a uniquely integrative space for this type of risk reasoning because it can connect physical processes (storm systems, drainage basins, coastal dynamics) with spatial planning, land use, and social vulnerability (Morote-Seguido & Olcina-Cantos, 2021; Mitchell, 2023). The implication for flood risk education is that "content coverage" is insufficient: learners must be scaffolded to think geographically across scales, through maps and territory interpretation, and with attention to the coupled human environment system (Morote-Seguido et al., 2024; Lee et al., 2019; Morote & Pérez, 2019).

3.2 Socio-territorial resilience as an educational outcome

Recent studies in the corpus increasingly frame flood education within "resilience" language, including socio-territorial resilience—an emphasis on how territories (communities, institutions, infrastructures, and cultures) anticipate, absorb, and adapt to extreme events (Morote-Seguido & Hernández-Hernández, 2021; Gómez-Trigueros & Morote-Seguido, 2025; Morote-Seguido et al., 2024). In this framing, education contributes by developing shared interpretive tools (risk literacy), strengthening preparedness norms, and enabling civic agency (e.g., understanding planning choices, advocating for risk reduction, or participating in adaptation strategies) (Williams et al., 2017; McEwen et al., 2014; Gary et al., 2014).

However, resilience is not produced automatically by information. Several interventions show gains in knowledge or risk perception without consistent change in preparedness intentions, indicating

that cognitive outcomes may not translate directly into behavioral or collective-action outcomes (Bosschaart et al., 2016; Ahn et al., 2020; Intaramuean et al., 2024). This pattern suggests that education must explicitly connect understanding to feasible actions at household, school, and community levels, and must address the affective and social dimensions of preparedness (fear, trust, efficacy, and collective norms) (Bosschaart et al., 2016; Williams et al., 2017; Morote-Seguido et al., 2024).

3.3 The "risk information ecology": textbooks, media, and digital channels

A defining feature of the recent literature is the recognition that students and future teachers learn about climate-related hazards through an ecology of sources, not only through formal schooling. Children's information channels are often digital and media-driven (e.g., television, Internet, social networks), which can introduce misinformation or oversimplified framings (Morote-Seguido & Hernández-Hernández, 2022; Morote et al., 2021). Parallel work in teacher populations shows continued reliance on textbooks even in the ICT era, alongside teacher concerns that textbook treatments are not fully adequate (Morote-Seguido & Hernández-Hernández, 2023).

This matters because textbooks can structure what counts as "official knowledge" in classrooms. When textbook content under-defines risk or overemphasizes catastrophism, teachers who lack deep disciplinary training may reproduce these limitations, unintentionally narrowing students' capacity for critical interpretation (Olcina, 2017; Morote-Seguido & Olcina-Cantos, 2021; Morote-Seguido et al., 2023). In the corpus, these dynamics are linked to the broader issue of teacher preparedness, especially in primary teacher education programs where pedagogical strategy training may dominate over disciplinary risk content, yielding what has been described as "the teaching of nothing" (Gómez-Carrasco et al., 2021; Parra & Morote, 2020; Morote-Seguido & Hernández-Hernández, 2021).

4. What do learners know about floods and related hazards?

4.1 Student knowledge and training exposure

Recent survey-based evidence indicates substantial gaps in formal training about floods at basic education levels. In a large study of schoolchildren in the Region of Valencia (Spain), only a minority reported having received training on floods, and many were unsure whether floods are addressed in textbooks (Morote-Seguido et al., 2024). Similar patterns are reported in flood-prone areas of South Thailand, where most final-year primary students had not received flood training and showed low levels of flood knowledge, risk perception, and preparedness (Intaramuean et al., 2024). These findings align with broader observations that hazard education is often unevenly implemented, even where curricular frameworks require it (Morote-Seguido et al., 2023; Lechowicz & Nowacki, 2014).

The drivers of these gaps appear multi-level. At the classroom level, teachers may lack confidence and resources to teach risk content in a scientifically rigorous way (Morote-Seguido & Hernández-Hernández, 2021; Gómez-Trigueros & Morote-Seguido, 2025). At the materials level, textbooks may provide incomplete risk explanations that focus mainly on the physical event, leaving exposure and vulnerability underdeveloped (Morote-Seguido et al., 2023). At the broader information level, students and teachers may rely on media channels that can amplify sensational framing or misinformation (Morote-Seguido & Hernández-Hernández, 2022; Morote et al., 2021).

4.2 Risk perception, emotion, and preparedness

Risk perception is frequently treated as a desirable intermediate outcome: if students perceive floods as relevant and potentially damaging, they may be more inclined toward preparedness. Program evaluations support partial versions of this logic. In the Netherlands, a flood-risk education program increased risk perception among 15-year-old students while fear and trust remained stable; however, preparedness intentions did not change (Bosschaart et al., 2016). This is a crucial result: raising risk salience may not be sufficient to shift intentions without additional supports such as self-efficacy, action knowledge, or family/community alignment.

The Thailand study similarly highlights that preparedness is shaped by multiple factors: flood training, information sources (friends, social media, YouTube), learning experiences, emotional responses, and existing risk perception (Intaramuean et al., 2024). Together, these findings point toward an educational design principle: preparedness emerges from a network of cognitive (knowledge), affective (emotion), and social (norms and information pathways) mechanisms, rather than from knowledge alone (Bosschaart et al., 2016; Williams et al., 2017; Intaramuean et al., 2024).

4.3 Educational continuity and vulnerability

Flood impacts on education are not only about preparedness learning; they also include disruption, absenteeism, infrastructure damage, and health burdens. Work in Zimbabwe describes how flood disasters can reduce learning hours, contribute to absenteeism, and undermine academic performance, while also stressing the need for safety cultures, infrastructure standards, and disaster education (Mudavanhu, 2015). This perspective is essential for a comprehensive review because it frames flood risk education as both (i) learning about floods and (ii) protecting educational systems from flood impacts. Such a dual framing strengthens the rationale for integrating DRR into school governance, teacher roles, and community coordination—not merely into isolated lessons (Lechowicz & Nowacki, 2014; Mudavanhu, 2015; Hiromi et al., 2021).

5. Pedagogical approaches and evidence on learning outcomes

5.1 Experience-based learning, role-play, and simulation

Across the corpus, experiential and participatory methods appear consistently valued by both teachers and students. Needs analysis work in South Korea indicates strong preference for experience-based learning in flood disaster safety education, alongside evidence supporting role-play and simulation as tools for improving learning outcomes (Ahn et al., 2020). Similarly, role-play has been used in higher education and professional stakeholder contexts to support expert communication and engagement around flood risk management (McEwen et al., 2014). These studies converge on a key pedagogical mechanism: simulated or enacted experiences make risk concepts concrete, enable perspective-taking, and allow rehearsal of decision-making under uncertainty (Ahn et al., 2020; McEwen et al., 2014).

Yet, experience-based methods must be carefully designed to avoid substituting "dramatic experience" for disciplined understanding. Without explicit conceptual scaffolding—especially the integration of hazard, exposure, and vulnerability—role-play can risk reinforcing simplistic narratives of floods as uncontrollable events rather than socio-territorial risks (Morote-Seguido et al., 2023; Olcina, 2017). The stronger studies embed experience-based activities within curricular reasoning tasks (interpretation, mapping, explanation, and reflection) and connect learning to feasible preparedness and adaptation actions (McEwen et al., 2014; Williams et al., 2017; Morote-Seguido et al., 2024).

5.2 Action-based and intergenerational learning

Intergenerational, action-based learning approaches seek to move beyond classroom knowledge toward civic engagement, often in relation to climate change and floods. Evidence from the UK indicates the potential of intergenerational action-based learning for flood education, positioning students not just as recipients of information but as participants in community-oriented understanding and action (Williams et al., 2017). This aligns with the broader argument that flood education should cultivate agency and participatory consciousness, a theme that recent teacher-focused studies also emphasize under the banner of citizen awareness and socio-territorial resilience (Gómez-Trigueros & Morote-Seguido, 2025).

However, action-based learning is not automatically empowering; it can become performative if institutional constraints limit real participation or if students lack the analytic tools to interpret evidence and trade-offs. Therefore, action-based models are strongest when paired with authentic learning projects that connect to real data, local territory interpretation, and multidisciplinary inquiry (Lee et al., 2019; Mitchell, 2023; Morote-Seguido et al., 2024).

5.3 Authentic projects and transformative education

In higher education and multidisciplinary training contexts, flood risk reduction programs using authentic learning projects report benefits in student engagement and learning through real-world problem framing (Lee et al., 2019). In parallel, climate change education scholarship frames climate change as a "wicked problem" that challenges education systems lacking inquiry-based pedagogy and well-prepared teachers, arguing for geography education as a unifying space for holistic climate education (Mitchell, 2023). Although climate change education is not identical to flood risk education, the two are tightly linked within the corpus because floods are frequently discussed as climate-amplified extremes, and because the same instructional challenges recur: complex causality, politicized discourse, and the need to integrate physical science with social understanding (Sánchez-Almodóvar et al., 2023; Morote-Seguido & Olcina-Cantos, 2021; Mitchell, 2023).

From this perspective, flood risk education benefits from transformative approaches that emphasize systems thinking, place-based inquiry, and reflective engagement with uncertainty and trade-offs (Mitchell, 2023; Gisore & Njurai, 2023). Yet the transformation is constrained when teachers lack the disciplinary background or confidence to enact inquiry-rich teaching, which returns attention to teacher education (Morote-Seguido & Hernández-Hernández, 2021; Gómez-Trigueros & Morote-Seguido, 2025).

5.4 Fieldwork, place interpretation, and geographic literacy

Fieldwork and place-based didactic proposals are prominent in the Spanish contributions of the corpus. A field trip proposal to La Marjal floodable park emphasizes interpreting risk spaces in a coastal area and supporting geographic understanding through direct territorial engagement (Morote, 2017). Complementary work uses fieldwork to improve comprehension of flood risk in specific localities (Morote & Pérez, 2019). These approaches operationalize a core geographic claim: risk understanding is strengthened when learners connect abstract concepts (e.g., floodplain, drainage, vulnerability) to the tangible features and social uses of their own environment.

Field-based learning also addresses a key limitation of textbook-centered instruction: it can anchor learning in simplified or decontextualized representations. When implemented rigorously, fieldwork functions as a corrective, enabling students to test claims against observed territory and to explore how urban planning, infrastructure, and land use shape exposure (Morote-Seguido et al., 2023; Morote, 2017; Morote & Pérez, 2019). The challenge, again, is teacher capacity: fieldwork requires knowledge, planning, and institutional support, and may be more feasible in secondary geography contexts than in generalist primary classrooms (Morote-Seguido & Hernández-Hernández, 2021; Gómez-Carrasco et al., 2021).

5.5 GIS-supported teaching and risk visualization

A major recent development is the use of GIS-based resources and territorial viewers to teach flood risk through spatial visualization and interpretation. Didactic proposals built around a territorial flood risk prevention plan viewer (PATRICOVA) are designed to help students interpret immediate territory and develop resilience-oriented understanding (Morote-Seguido et al., 2024). This approach is significant for two reasons. First, it makes "risk" visible as a spatial pattern that can be interrogated (where are flood-prone zones, what assets are exposed, how do mitigation infrastructures appear). Second, it supports inquiry: students can ask why risk is distributed as it is and how planning and adaptation modify that distribution (Morote-Seguido et al., 2024; Lee et al., 2019).

Nonetheless, GIS tools are not pedagogically self-sufficient. Without guidance, students may treat risk maps as authoritative artifacts rather than as representations constructed from assumptions and models. Effective GIS-based teaching therefore requires explicit attention to interpretation, uncertainty, and the human dimensions of exposure and vulnerability (Morote-Seguido et al., 2023; Mitchell, 2023; Morote-Seguido et al., 2024).

6. Teacher preparation: the central bottleneck

6.1 Evidence of limited preparedness among pre-service teachers

A consistent finding across the teacher-focused literature is that pre-service teachers often report low or medium confidence in teaching flood risk, with many indicating that they did not receive substantial training during school or university stages (Morote-Seguido & Hernández-Hernández, 2021; Sánchez-Almodóvar et al., 2023; Gómez-Trigueros & Morote-Seguido, 2025). In the Sustainability study of future teachers (primary and secondary), participants reported only medium preparedness to teach flood risk, with many describing insufficient training and limited capacity to propose instructional resources (Morote-Seguido & Hernández-Hernández, 2021). Other work likewise indicates that even when some training exists, it may be brief or superficial, leaving teachers reliant on textbooks and emergency protocols (Morote-Seguido & Hernández-Hernández, 2021; Morgan, 2012).

An important nuance is disciplinary differentiation. Where teacher candidates have undergraduate backgrounds in geography or related disciplines, reported training and preparedness may be higher than for generalist primary education candidates (Morote-Seguido & Hernández-Hernández, 2021; Gómez-Trigueros & Morote-Seguido, 2025). This suggests that the key variable is not merely "teacher education level," but access to coherent disciplinary knowledge that can be transformed into teachable representations.

6.2 "Teaching of nothing" and the pedagogy–discipline imbalance

The corpus raises a pointed critique of initial teacher education, especially in primary programs: pedagogical training may dominate while disciplinary foundations receive less attention, leading to graduates who can enact generic strategies but struggle to teach complex geographic topics like flood risk (Gómez-Carrasco et al., 2021; Parra & Morote, 2020; Morote-Seguido & Hernández-Hernández, 2021). This has been described as producing "the teaching of nothing," meaning that pedagogy is unmoored from disciplinary substance.

This imbalance is not unique to flood risk; it echoes broader concerns about climate change education, where teachers may not fully know both physical and social aspects of the topic, limiting inquiry-based teaching and reinforcing fragmented understanding (Mitchell, 2023; Morote-Seguido & Olcina-Cantos, 2021). The implication for flood risk is direct: improving teaching quality requires an integrated model in which pedagogical strategies are learned alongside, and through, core geographic risk concepts.

6.3 Teacher literacy demands and professional identity

Teaching risk content also involves literacy demands: teachers must navigate scientific terminology, interpret graphs and maps, and translate complex causal systems into age-appropriate explanations. Research on teachers' subject-specific literacy needs highlights how teacher identity and capacity are shaped by these demands (Morgan, 2012). For flood risk education, this means professional development must include not only factual content but also interpretive practices: reading risk maps, critiquing media narratives, evaluating textbook images, and facilitating student argumentation about risk and adaptation (Morote-Seguido & Hernández-Hernández, 2023; Morote-Seguido et al., 2023; Mitchell, 2023).

6.4 In-service training and school roles in disasters

Beyond classroom teaching, teachers may hold operational roles during disasters, especially in contexts where schools serve as shelters or evacuation centers. Training studies focusing on communication and shelter management underscore the need for professional preparation that spans educational continuity and disaster management functions (Hiromi et al., 2021). This reinforces a broader conclusion: teacher capacity for flood risk education should be connected to institutional preparedness planning, not treated as an isolated curricular topic (Lechowicz & Nowacki, 2014; Mudavanhu, 2015; Hiromi et al., 2021).

7. Textbooks, images, and media: material infrastructures of risk knowledge

7.1 Flood risk in textbooks: missing definitions and narrowed causality

A major recent contribution analyzes how flood risk is explained in Spanish primary social science textbooks. The findings indicate that textbooks often lack a complete definition of flood risk and focus mainly on the physical factor (the atmospheric event), with limited attention to how human factors shape risk through exposure and vulnerability (Morote-Seguido et al., 2023). From a risk literacy standpoint, this is consequential: if students learn that floods are "caused by rain" without understanding settlement patterns, land-use policy, infrastructure, and vulnerability, they may interpret disasters as inevitable rather than as partially preventable socio-territorial outcomes.

This textbook pattern also helps explain why teachers and students may struggle to generate diverse didactic proposals: if textbooks provide narrow framings, and if teachers lack additional training, instruction may remain transmissive and event-focused (Morote-Seguido & Hernández-Hernández, 2021; Gómez-Trigueros & Morote-Seguido, 2025). The result is curricular compliance without conceptual depth.

7.2 Images, catastrophism, and the affective framing of hazards

Textbook and media representations can shape the emotional tone of hazard learning. Earlier scholarship in the corpus notes that textbooks and media can contain errors, excessive catastrophism, and lack scientific rigor in relation to climate and extreme risks (Olcina, 2017; Morote-Seguido & Hernández-Hernández, 2021). Recent work extends this concern to the analysis of images in educational materials (including climate-related themes), emphasizing the need for rigor and avoiding extremism in representations (Morote et al., 2025).

A key insight is that catastrophism can have ambiguous educational effects. While dramatic images may heighten attention and risk salience, they may also foster fatalism or anxiety without corresponding efficacy, thereby weakening preparedness intentions (Bosschaart et al., 2016; Mitchell,

2023). Flood risk education therefore requires a balanced affective design: acknowledging seriousness while emphasizing actionable knowledge and community capacity.

7.3 Media channels and digital misinformation risks

The corpus documents strong reliance on digital media for climate-related information among students, with increasing risk of misinformation as reliance grows with age (Morote-Seguido & Hernández-Hernández, 2022). Parallel evidence in pre-service teacher populations indicates that future teachers may also draw heavily on broadcast media and the Internet for climate-related topics (Morote et al., 2021), suggesting that teacher education must include critical media literacy as part of disciplinary preparation.

This requirement is not a peripheral add-on. If teachers reproduce media framings, they may import sensational narratives or conceptual confusions into classrooms, especially when textbooks are also incomplete or outdated (Morote-Seguido & Hernández-Hernández, 2023; Morote-Seguido et al., 2023). Therefore, an updated model of flood risk education must treat media and textbook critique as core competencies.

8. Summary tables of the evidence base

Table 1. Empirical Research On Flood Risk Learning, Perception, And Preparedness (Students And Communities)

Context / setting	Participants / level	Design / method	Pedagogical or exposure focus	Key findings	Ref.
Netherlands	15-year-old students (n≈271)	Program evaluation	Flood-risk education program	Increased risk perception; fear/trust stable; preparedness intentions unchanged	(Bosschaart et al., 2016)
South Korea (Daegu)	Students & teachers	Needs/awareness analysis	Flood disaster school safety education	Strong preference for experience-based learning; supports role-play approaches	(Ahn et al., 2020)
UK	School learners	Action-based learning study	Intergenerational learning on floods	Demonstrates potential for action-based learning in flood education	(Williams et al., 2017)
Thailand (South)	Primary students (n≈784)	Cross-sectional survey	Flood knowledge, FRP, preparedness	Low knowledge/FRP/preparedness; training rare; info sources & emotions matter	(Intaramuean et al., 2024)
Spain (Valencia)	Primary–baccalaureate students (n≈926)	Survey	Flood training, knowledge, perceptions	Limited training; many unsure about textbook coverage; perceive climate link to floods	(Morote-Seguido et al., 2024)
Zimbabwe	Schoolchildren / schooling system	Qualitative/impact study	Flood impacts on education	Floods reduce learning time; absenteeism and health risks; recommends safety culture & codes	(Mudavanhu, 2015)
Poland (conceptual)	School education	Conceptual/positioning	DRR through schooling	Frames school education as an element of disaster risk reduction	(Lechowicz & Nowacki, 2014)
Spain	Social sciences education	Didactic resource study	Press/newspapers as resources	Media coverage used as educational resource for flood events	(Cuello, 2018)

Table 2. Teacher Preparation And Instructional Resources For Flood Risk And Climate-Related Hazards

Context / setting	Participants	Design / method	Resource / focus	Key implications for teaching	Ref.
Spain (Valencia)	Pre-service teachers (primary + MAES)	Survey + analysis	Preparedness, training memories, didactic proposals	Medium preparedness; training often insufficient; limited creativity/resources; disciplinary differences	(Morote-Seguido & Hernández - Hernández, 2021)
Spain (multi-university)	Pre-service + in-service teachers (N≈784)	Mixed questionnaire	Citizen awareness; teacher training adequacy	Limited training; negative perception of preparedness; traditional didactics persist; calls for resilience-oriented training	(Gómez-Trigueros & Morote-Seguido, 2025)
Spain	Geography teachers (n≈96)	Survey	Climate change in textbooks; teaching practices	Continued textbook role; perceived inadequacies; reliance on everyday examples and expert talks	(Morote-Seguido & Hernández - Hernández, 2023)
Spain	Textbooks (primary social science)	Content + image analysis	Flood risk definitions/causes/images	Incomplete risk definitions; emphasis on physical causes; limited exposure/vulnerability framing	(Morote-Seguido et al., 2023)
Spain	Trainee teachers	Chapter-based analysis	Social representations & didactic proposals	Training often present but proposal creativity limited; risk of classroom avoidance	(Morote-Seguido, 2022)
Spain	Secondary/baccalaureate geography	Didactic proposal	GIS viewer (PATRICOVA)	GIS supports place interpretation and resilience learning; requires interpretive scaffolding	(Morote-Seguido et al., 2024)
United States	Education systems (review)	Literature + standards review	"Wicked" climate change education	Standards gaps, inquiry deficits, ill-prepared teachers; geography as integrative space	(Mitchell, 2023)
Japan	Teachers & public health nurses	Pilot training evaluation	Disaster communication for shelter management	Training supports operational preparedness roles; highlights expanded teacher responsibilities	(Hiromi et al., 2021)
Spain	Teacher education	Handbook / synthesis	History & geography teacher education	Reinforces need to integrate disciplinary knowledge with pedagogy	(Gómez-Carrasco et al., 2021)
Spain	Teacher education research	Empirical study	Teacher knowledge representations	Supports diagnosis of disciplinary–didactic	(Parra & Morote, 2020)

Context / setting	Participants	Design / method	Resource / focus	Key implications for teaching	Ref.
				knowledge tensions in training	

9. Integrative discussion: what works, what fails, and why

9.1 Why knowledge gains do not reliably yield preparedness

Across the reviewed studies, a common pattern is that interventions can improve certain cognitive and perceptual outcomes, but effects on preparedness intentions are inconsistent (Bosschaart et al., 2016; Ahn et al., 2020; Intaramuean et al., 2024). This pattern can be interpreted through three interacting mechanisms.

First, preparedness requires action knowledge and efficacy, not just risk recognition. Students may learn that floods are dangerous without learning what to do (procedural knowledge) or believing they can do it (self-efficacy) (Bosschaart et al., 2016; Williams et al., 2017). Second, preparedness is socially embedded; household norms, community resources, and trust in institutions shape whether learning becomes action (Intaramuean et al., 2024; Mudavanhu, 2015). Third, affect matters: catastrophist framings can heighten fear without increasing efficacy, risking fatalism (Olcina, 2017; Morote et al., 2025; Mitchell, 2023).

Therefore, a resilience-oriented curriculum should explicitly connect risk reasoning to feasible and context-appropriate preparedness actions at multiple scales: personal (knowing warnings), household (plans and kits), school (drills, roles), and community (understanding territorial planning and mitigation) (Lechowicz & Nowacki, 2014; Mudavanhu, 2015; Hiromi et al., 2021; Morote-Seguido et al., 2024).

9.2 The centrality of teacher capacity and didactic creativity

Teacher education emerges as the key bottleneck. Even where flood risk is mandated in curricula, teachers may feel unprepared and lack resources, leading to reliance on textbooks or avoidance of the topic (Morote-Seguido & Hernández-Hernández, 2021; Gómez-Trigueros & Morote-Seguido, 2025). Moreover, pre-service teachers can value the importance of teaching floods and resilience while still reporting limited capacity to design didactic proposals (Morote-Seguido & Hernández-Hernández, 2021; Morote-Seguido, 2022).

This suggests that teacher education must target "didactic creativity" as a structured competence: the ability to design learning sequences that integrate (i) accurate risk content, (ii) engaging pedagogy, and (iii) locally grounded resources. Evidence points to several promising anchors for this competence: role-play and simulations (Ahn et al., 2020; McEwen et al., 2014), action-based learning (Williams et al., 2017), authentic projects (Lee et al., 2019), fieldwork (Morote, 2017; Morote & Pérez, 2019), and GIS-supported interpretation (Morote-Seguido et al., 2024). Teacher education should treat these not as optional "activities," but as vehicles for teaching core risk reasoning.

9.3 Repairing the textbook–media problem: from consumption to critique

The evidence base indicates that both students and teachers draw information from digital media, and teachers continue to use textbooks extensively (Morote-Seguido & Hernández-Hernández, 2022; Morote-Seguido & Hernández-Hernández, 2023). If textbooks provide incomplete risk definitions and emphasize physical causes, and if media amplify sensational narratives, then flood risk education risks becoming both conceptually thin and affectively distorted (Morote-Seguido et al., 2023; Olcina, 2017; Morote et al., 2025).

A practical implication is that "critical literacy" must be integrated into flood risk teaching: students should learn to ask what is missing from an explanation (Where are exposure and vulnerability?), to compare claims across sources, and to interpret images and maps critically (Morote-Seguido et al., 2023; Mitchell, 2023; Morote-Seguido et al., 2024). Teachers, in turn, must be trained to curate and correct textbooks/media with supplementary, scientifically grounded resources.

9.4 Geography as the integrative disciplinary home

Multiple contributions identify geography education as particularly well positioned to integrate physical and social dimensions of climate-related hazards (Morote-Seguido & Olcina-Cantos, 2021; Mitchell, 2023). The strongest flood education designs in the corpus are those that treat floods as

territorial phenomena: they emphasize place interpretation, spatial visualization, and human–environment coupling (Morote, 2017; Morote & Pérez, 2019; Morote-Seguido et al., 2024). This does not imply that flood risk education belongs only in geography; rather, geography can function as a curricular hub that coordinates science, social studies, and civic education around coherent risk reasoning (Mitchell, 2023; Sánchez-Almodóvar et al., 2023).

10. Research and practice agenda

10.1 Priority research gaps

a. From cross-sectional surveys to longitudinal learning trajectories. Much evidence is snapshot-based (e.g., student knowledge and perceptions at one time point). Future studies should examine how flood risk understanding develops across schooling stages and how interventions influence retention and behavior over time (Morote-Seguido et al., 2024; Intaramuean et al., 2024; Sánchez-Almodóvar et al., 2023).
b. Mechanisms linking pedagogy to preparedness. The inconsistency between improved risk perception and unchanged preparedness intentions requires mechanism-focused research that measures efficacy, action knowledge, and social norms (Bosschaart et al., 2016; Williams et al., 2017; Intaramuean et al., 2024).
c. Teacher education intervention studies. The field has strong diagnostic evidence of low preparedness, but fewer rigorous evaluations of teacher training models that integrate disciplinary risk reasoning, didactic design, and critical literacy (Morote-Seguido & Hernández-Hernández, 2021; Gómez-Trigueros & Morote-Seguido, 2025; Morgan, 2012).
d. Textbook and media ecologies across contexts. Recent textbook analyses provide a template for evaluating how risk is represented; future work should examine cross-national differences, image framing, and the interplay between textbooks and digital media use (Morote-Seguido et al., 2023; Morote-Seguido & Hernández-Hernández, 2022; Morote et al., 2025).
e. Equity, vulnerability, and educational disruption. Flood risk education must incorporate how vulnerability shapes unequal impacts, including educational disruption, absenteeism, and health burdens, as highlighted by disaster impact studies (Mudavanhu, 2015; Lechowicz & Nowacki, 2014).

10.2 Actionable recommendations for educators and policymakers

a. Adopt a “risk triad” learning progression. Ensure every unit explicitly teaches floods through hazard, exposure, and vulnerability moving beyond event description to territorial risk explanation (Morote-Seguido et al., 2023; Morote-Seguido & Olcina-Cantos, 2021).
b. Institutionalize experience-rich learning with conceptual scaffolding. Expand role-play, simulations, fieldwork, and authentic projects, but embed them within structured reasoning tasks (Ahn et al., 2020; McEwen et al., 2014; Lee et al., 2019; Morote, 2017).
c. Build teacher capacity through integrated disciplinary–didactic modules. Teacher education should couple pedagogical strategies with deep content and literacy practices (maps, texts, media critique), addressing the pedagogy–discipline imbalance (Gómez-Carrasco et al., 2021; Parra & Morote, 2020; Morote-Seguido & Hernández-Hernández, 2021).
d. Reframe textbooks as objects of critique, not as curriculum. Train teachers and students to identify missing risk components and to evaluate image framing and source reliability (Morote-Seguido et al., 2023; Morote-Seguido & Hernández-Hernández, 2023; Morote-Seguido & Hernández-Hernández, 2022).
e. Leverage GIS and territorial viewers for place interpretation. Integrate risk maps and viewers (e.g., territorial flood plans) to connect learning with local environments and adaptation planning, while teaching interpretive caution and uncertainty (Morote-Seguido et al., 2024; Mitchell, 2023).
f. Link curriculum to school preparedness governance. Because schools may function as shelters and teachers may have disaster roles, connect learning to institutional plans and communication training (Hiromi et al., 2021; Lechowicz & Nowacki, 2014).

4. CONCLUSION

The updated evidence base confirms that flood risk education is not primarily constrained by a lack of curricular intent; rather, it is constrained by teacher capacity, material ecologies (textbooks and

media), and the difficulty of translating risk understanding into preparedness and resilience. Across contexts, students often receive limited training, and teachers frequently report insufficient preparation and limited didactic creativity (Morote-Seguido & Hernández-Hernández, 2021; Morote-Seguido et al., 2024; Gómez-Trigueros & Morote-Seguido, 2025). Interventions that foreground experience, place interpretation, and inquiry role-play, action-based learning, authentic projects, fieldwork, and GIS resources show consistent benefits for knowledge and risk perception, though preparedness intentions remain harder to shift (Bosschaart et al., 2016; Ahn et al., 2020; Williams et al., 2017; Morote-Seguido et al., 2024).

To move from awareness to socio-territorial resilience, flood risk education must be reconstructed as an integrated system: coherent risk concepts (hazard–exposure–vulnerability), pedagogies that connect territory to science, and teacher education that treats critical textbook/media literacy as core professional competence (Morote-Seguido et al., 2023; Morote-Seguido & Hernández-Hernández, 2023; Mitchell, 2023). Within the climate emergency, the goal is not only better lessons about floods, but stronger civic capacity to interpret, anticipate, and reshape risk-producing territorial futures..

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