

Land Cover Change, Historical Memory and Resistance: GIS-Integrated Climate Adaptation Pedagogy from the 1976 Soweto Uprising

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Abstract

At a time when historical memory and environmental vulnerabilities overlap, rethinking how the 1976 Soweto Uprising is taught offers a pathway for cultivating critical engagement and climate-consciousness. This study addresses the pedagogical limitation wherein the 1976 Soweto Uprising is taught as a static historical event and disconnected from climate change adaptation and spatial inequality challenges. Employing a Systematic Literature Review (SLR) guided by the Preferred Reporting Items for Systematic Reviews and Meta-

Analyses (PRISMA) protocols, the study integrates spatial justice theory, critical pedagogy, and resilience thinking, positioning learning as historically grounded, spatially situated, and future-oriented. The findings reveal that Geographic Information Systems (GIS)-based digital mapping of protest geographies, when linked with present-day climate vulnerability and adaptive strategies, deepens learners' historical consciousness, spatial literacy, and capacity to connect past resistance with present resilience. Such integrative approaches foster critical awareness of environmental injustice and empower learners to envision sustainable futures. The study recommends integrating geospatial technologies, climate change adaptation frameworks, and teacher professional development in geo-humanities to advance transformative pedagogy. This approach provides a compelling model for bridging historical memory and environmental action in South African classrooms.

Keywords: Digital humanities; Geographic Information Systems (GIS); Spatial justice; Soweto Uprising; Transformative pedagogy.

Introduction

In an era of climate change and persistent social inequality¹, education is being fundamentally reimaged. The classroom is no longer a site for transmitting static historical facts but viewed as a crucial arena for fostering the critical consciousness, spatial literacy, and adaptive capacities necessary for navigating an uncertain future². This study proposes a radical re-envisioning of how foundational historical events, specifically the 1976 Soweto Uprising, can be taught. It argues that by integrating Geographic Information Systems (GIS) and a climate change adaptation framework, history education can be transformed from a passive exercise in remembrance into an active, empowering practice of resistance and resilience. The Soweto Uprising, which began on June 16, 1976, as a student protest against the apartheid regime's decree that Afrikaans be used as a medium of instruction in Black schools, stands as a watershed moment in South African history³. It marked a definitive shift in the anti-apartheid struggle, galvanising a new generation of activists and drawing unprecedented international attention to the brutal realities of racial segregation⁴⁵

¹ L Sealey-Huggins, *The climate crisis is a racist crisis: Structural racism, inequality and climate change. The fire now: Anti-racist scholarship in times of explicit racial violence* (London, UK: ZED Books, 2018), pp. 99-113.

² K Swargiary, *Navigating the modern classroom: A teacher's journey* (LAP, 2024).

³ L Fekisi, *A comparison of Drum's coverage of the 1976 Soweto student uprisings and the 2015# FeesMustFall student protests* (Master's dissertation, University of the Free State, 2018).

⁴ A Anisin, "Identity, repression, and the collapse of apartheid", *The Strategic Review for Southern Africa*, 43(2), 2021, pp. 308-336.

⁵ S Gukelberger, "Youth and the politics of generational memories: The Soweto uprising in South Africa", *Ateliers d'anthropologie: Revue éditée par le Laboratoire d'ethnologie et de sociologie comparative* (47), 2020.

The uprising was fundamentally a spatial event, a contestation over the right to the city, a violent expression of power mapped onto the bodies of young people in the streets of a specifically designed township, and a reaction to the spatial engineering of apartheid that confined Black South Africans to under-resourced, peripheral urban areas. The memory of 1976 is etched in the geography of Soweto (the Southwestern townships of Johannesburg), its layouts, its landmarks, and the enduring spatial inequalities that continue to shape the lives of its residents.

Despite its significance, the pedagogical treatment of the Soweto Uprising often suffers from historical sequestration⁶. It is frequently taught as a discrete, concluded event or a chapter in a textbook confined to the past, with limited connection to the lived realities of contemporary South Africa. This approach overlooks the spatial injustices that fuelled the uprising, which were not dismantled with the advent of democracy in 1994; they were, in many ways, reconfigured and persist today. The sprawling townships, characterised by inadequate housing, limited access to green spaces, and under-resourced infrastructure, are now also the very spaces most vulnerable to the impacts of climate change⁷. Communities in these areas face risks from extreme heat, flooding, and water scarcity, challenges that are a direct legacy of the apartheid-era spatial planning. The disconnect between historical pedagogy and present-day realities fail to equip learners with the tools to see the past as prologue and to understand the historical struggle as intimately linked to contemporary battles for spatial and environmental justice. The primary issue this study addresses is this pedagogical gap: the failure to leverage the teaching of historical events like the Soweto Uprising as a perspective through which to understand and act upon current crises, particularly climate change adaptation. While there is a robust body of literature on the history of the uprising, on digital humanities, and on climate change pedagogy, these fields remain largely siloed. Debates may arise from those who view the integration of a climate perspective as diluting or politicising the ‘pure’ historical narrative of the anti-apartheid struggle. The current study, however, contends that such integration is not a dilution, but a deepening that honours the memory of the 1976 students by demonstrating that their struggle against spatial oppression was an act of resilience, with lessons applicable to building adaptive capacity.

⁶ J Seroto, “Analysing the presentation of the 1976 Soweto uprising in Grade 9 history textbooks”, *Africa Education Review*, 15(4), 2018, pp. 1-19.

⁷ PI Onyemenam, “The green space paradox: Adaptive infrastructure and its displacement effects on low-income urban residents.” *International Journal of Rural and Urban Development*, 2(1), 2025, pp. 1-8.

The background context for this study is twofold. First, it is rooted in the history and ongoing spatial reality of Soweto's landscape of oppression and resistance. Second, it is anchored in the need for climate change adaptation in South Africa, a country identified as among the world's most vulnerable to its effects. The problem statement can be articulated as follows: Current pedagogical approaches to the 1976 Soweto Uprising, fail to cultivate in learners a conceptualisation of the enduring nature of spatial injustice and climate vulnerability. This represents a lost opportunity to foster the spatial literacy, historical consciousness, and adaptive resilience essential for engaged and transformative citizenship. The primary aim of this study is to synthesise interdisciplinary scholarship to develop and propose an innovative pedagogical model. This model will demonstrate how GIS-based digital mapping of the protest geographies of the 1976 Soweto Uprising can be effectively linked with present-day climate vulnerability data and adaptive strategies to create a powerful, transformative learning experience. To achieve this, the study is guided by the following research question: *How can the integration of GIS-based historical mapping of the 1976 Soweto Uprising with contemporary climate change adaptation frameworks foster spatial literacy, deepen historical consciousness, and cultivate resilience-thinking in South African learners?* The Spatial Justice Theory provides a theoretical understanding of how space is a product of social relations and a vehicle for (in)justice. Critical Pedagogy grounds the study in the imperative to create learning experiences that move learners from passive reception to critical agency. Also, Resilience Thinking provides the future-oriented framework by reframing the community's capacity to adapt, transform, and thrive in the face of disturbance and change, a capacity prefigured in the collective action of youth in 1976. In essence, this study posits that mapping the memory of resistance is an essential precursor to building the resilience of the future.

Literature review

Spatial justice theory

Spatial justice theory, principally developed through the work of geographer Edward Soja (2010) and building upon Henri Lefebvre's "production of space" concept⁸, posits that social justice is inherently geographical, focusing on the fair and equitable distribution of resources, services, and opportunities across space produced by social relations which in

⁸ S Przybylinski, "Spatial justice", J Ohlsson and S Przybylinski, *Theorising justice* (Bristol University Press, 2023), pp. 191-204. Bristol University Press.

turn, reinforces those relations.⁹ Soja's key contribution demonstrates how the organisation of space, the location of resources, the design of infrastructure, and the patterns of exclusion and inclusion are primary mechanisms through which power operates, and inequalities are sustained.¹⁰ For this study, spatial justice theory provides the essential connection between 1976 and 2026. Apartheid was a project of spatial engineering, because the Group Areas Act, the pass laws, the deliberate under-resourcing of townships like Soweto, and the imposition of Afrikaans as a medium of instruction were all spatial strategies designed to control, contain, and exploit Black South Africans.¹¹ The 1976 uprising was, therefore, a spatial rebellion, as young people took to the streets to reclaim space, to make them visible in public thoroughfares from which they were marginalised, and to challenge the spatial order of oppression.¹² Figure 1 depicts the spatial justice theory.

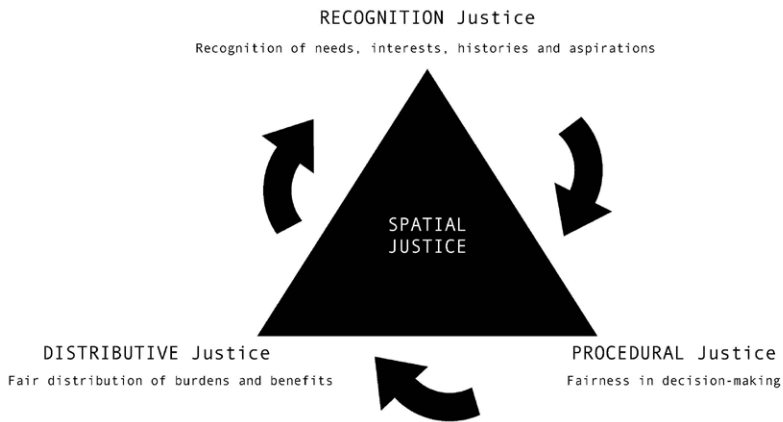


Figure 1: The spatial justice theory

Source: Rocco (2025)

⁹ R Rocco, *Spatial justice: The basics* (Routledge, 2026).
¹⁰ S Przybylinski, "Where is justice in geography? A review of justice theorizing in the discipline." *Geography Compass*, 16(3), 2022, p. e12615.
¹¹ F Adegale and T Mitchell, "The impact of the United Nations Human Rights Treaties on the domestic level in South Africa", *In The impact of the United Nations Human Rights treaties on the domestic level: Twenty years on* (Academic Publishers, 2024), pp. 1077-1146.
¹² J Seroto, "Analysing the presentation of the 1976 Soweto uprising...", *Africa Education Review*, 15(4), 2018, pp. 1-19

Spatial justice theory guided the search strategy by prioritising keywords and literature that address the spatial dimensions of both apartheid history and inequality. It directs attention to scholarship on apartheid urban planning, township geography, and post-apartheid spatial continuity. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol is operationalised using the following spatial keywords: ‘Soweto geography’, ‘apartheid spatial planning’, ‘township morphology’, and ‘post-apartheid spatial inequality’. This ensures that the literature reviewed is not merely historical, but geographically informed. Also, spatial justice theory provided the analytical lens for identifying how the protest routes of 1976 intersect with contemporary climate vulnerability maps, the areas that witnessed the fiercest resistance then, that are now most susceptible to flooding or extreme heat. The theory also transformed historical photographs, GIS coordinates, climate models, and oral histories into a coherent narrative about the enduring nature of spatial injustice.

Critical pedagogy

Critical pedagogy, rooted in the work of Paulo Freire (1970), the theory challenges the ‘banking model’ of education, which advocates for a problem-posing education that is dialogical and transformative. The goal is *conscientização* (critical consciousness), that is, the ability to perceive social, political, and economic contradictions and to act against the oppressive elements of reality. For this study, critical pedagogy is indispensable, because the research question itself is pedagogical. It asks what should be taught about the Soweto Uprising, and how to foster critical engagement and climate consciousness. The theory positions the learner as an active agent in the construction of knowledge. Figure 2 depicts the composition of the critical pedagogy word cloud terms stock illustration.



Figure 2: Critical pedagogy word cloud composition terms stock illustration

Source: Shutterstock (2026)

By applying the critical pedagogy to the current study, the very identification of the pedagogical gap as a problem emerges from theory. As current teaching methods are inadequate because they are disempowering and treating history as a closed chapter, learners are denied the opportunity to see themselves as historical actors capable of shaping the future. The problem statement, therefore, reflects the critical pedagogue's commitment to education as a practice of freedom. Further, the theory bridges the spatial justice theory and resilience thinking towards achieving transformative educational practice. Critical pedagogy provides the 'how', that is, the methodological principles for designing learning experiences that empower learners to connect past, present, and future. Regarding the proposed pedagogical model, GIS mapping exercise is designed according to critical pedagogy principles as a student-centred inquiry project. Learners formulate their own questions about the relationship between past protest and present vulnerability. They engage in dialogue with peers, community members, and digital resources. The technology becomes a tool for problem-posing: 'Why is this area flood-prone? Was it always this way? What did people here do in 1976? What can we learn from them?' The final output is not merely a map, but a critical analysis and potentially, a proposal for community action embodying Freire's insistence that critical consciousness must lead to transformative action.

Resilience thinking: The future-oriented framework

Resilience thinking originates in ecology, particularly the work of CS Holling (1973), and has been adapted for social-ecological systems¹³ and is understood as the capacity of a system, for example, an ecosystem, a community, or a city to absorb disturbance, reorganise while undergoing change, and retain essentially the same function, structure, identity, and feedback.¹⁴ In social contexts, it encompasses adaptive capacity (the ability to learn and adjust) and transformative capacity (the ability to create fundamentally new systems when the old ones become untenable).¹⁵ Figure 3 depicts the resilience thinking theory.

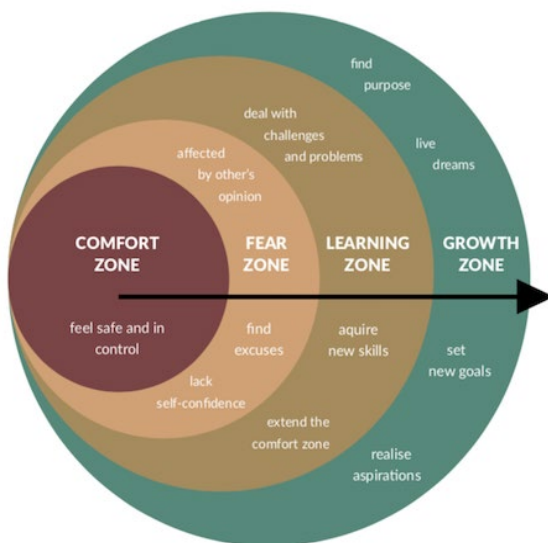


Figure 3: The resilience thinking theory

Source: Maguire (2020)

¹³ HD Hellige, "The metaphorical processes in the history of the resilience notion and the rise of the ecosystem resilience theory", M Ruth and S Goessling-Reisemann, *Handbook on resilience of socio-technical systems* (Edward Elgar Publishing, 2019), pp. 30-51.

¹⁴ NM Lister, "(Re) Think (Re) design for resilience", In: *Sustainable Coastal Design and Planning* (CRC Press, 2018), pp. 35-49.

¹⁵ JC Canizares, SM Copeland, and N Doorn, "Making sense of resilience", *Sustainability*, 13(15), 2021, p. 8538.

For this study, resilience thinking is crucial because it reframes the Soweto Uprising as an event of resistance and an act of community resilience.¹⁶ The youth of 1976, in the face of overwhelming state violence, demonstrated extraordinary adaptive and transformative capacity. They reorganised their social structures (forming the Soweto Students' Representative Council), learned rapidly from events, and ultimately contributed to the transformation of the entire political system.¹⁷ This historical resilience holds direct lessons for contemporary climate adaptation. Resilience thinking guided in framing the research question. The inclusion of 'resilience' in the research question signals that the study demands a future-oriented dimension. With reference to South African education, the cognitive capacity to approach contemporary challenges with the adaptive and transformative mindset was demonstrated by historical actors. The study's recommendations for teacher professional development are informed by resilience thinking. Teachers need pedagogical capacity to foster adaptive learning environments where students feel empowered to grapple with uncertainty, complexity, and contested knowledge, the very conditions of resilience.

Methodology

The current study employs a qualitative research design grounded in a Systematic Literature Review (SLR) approach, guided by PRISMA protocols.^{18 19} The PRISMA framework was selected for its rigorous, transparent, and replicable procedures, which ensure that the synthesis of existing scholarship is conducted with methodological integrity and can be critically evaluated by the academic community. Given the interdisciplinary nature of the research question, which bridges digital humanities, GIS education, climate change pedagogy, and South African history education, an SLR is particularly appropriate, as it enables the systematic identification, evaluation, and synthesis of diverse bodies of literature that might otherwise remain siloed within their respective disciplines. The objective is not merely to summarise existing research, but to integrate findings across fields to generate new theoretical and pedagogical insights that could not emerge from a single disciplinary perspective alone. The literature search strategy was developed iteratively to capture the full

¹⁶ J Thubron and R Sacks, Rethinking resilience: South Africa and self-reliance, *Social Dynamics*, 48(1), 2022, pp. 2-15.

¹⁷ R Cohen and W Cobbett, (eds.), *Popular struggles in South Africa* (Taylor & Francis, 2024).

¹⁸ D Pati, and LN Lorusso, "How to write a systematic review of the literature", *HERD: Health Environments Research & Design Journal*, 11(1), 2018, pp. 15-30.

¹⁹ PC Sauer and S Seuring, "How to conduct systematic literature reviews in management research: A guide in 6 steps and 14 decisions", *Review of Managerial Science*, 17(5), 2023, pp. 1899-1933.

breadth of scholarship relevant to the study's tripartite theoretical framework. Electronic searches were conducted across multiple academic databases, including Scopus, Web of Science, ERIC (Education Resources Information Center), JSTOR, and Google Scholar, ensuring comprehensive coverage of both education-focused and interdisciplinary literature. The search employed a combination of keywords and Boolean operators, grouped thematically to reflect the study's core conceptual domains. For the historical and spatial dimensions, search terms included "Soweto Uprising 1976", "apartheid education", "township geography", and "spatial justice South Africa". For the digital and pedagogical dimensions, terms included "GIS in education", "digital humanities", "geospatial technologies secondary schools", and "transformative pedagogy". For the climate and resilience dimensions, search terms included "climate change adaptation education", "climate vulnerability South Africa", "community resilience", and "environmental justice curriculum". The reference lists of included studies were also hand-searched to identify additional relevant publications through a snowballing technique, ensuring that seminal works and emerging scholarship were not overlooked.

The study employed clearly defined inclusion and exclusion criteria to ensure the quality and relevance of the sources synthesised. Inclusion criteria encompassed peer-reviewed journal articles, scholarly books, and conference proceedings published in English post-2018. While the direct inclusion of pre-2018 primary sources would have been methodologically ideal, the post-2018 corpus, when combined with backward citation tracing proved sufficient for capturing all essential concepts, empirical findings, and theoretical debates from the earlier foundational literature. This timeframe was deliberately chosen to capture scholarship produced in the democratic era, reflecting both the post-apartheid reimagining of history education and the parallel development of digital technologies and climate change discourse. Furthermore, studies were included if they addressed at least one of the core thematic areas, namely South African history education, GIS or digital humanities in educational contexts, climate change pedagogy, or spatial justice theory and if they demonstrated clear relevance to the South African context or offered transferable insights applicable to similar post-colonial or spatially unequal settings. Exclusion criteria eliminated non-academic sources, such as opinion pieces and blog posts, studies not available in full text, and publications that addressed GIS, climate change, or history education in purely technical terms without pedagogical or social justice considerations.

Data extraction and synthesis were conducted through a thematic analysis approach aligned with the study's theoretical framework. A data extraction sheet was developed to capture key information from each included source, including author(s), year of publication, disciplinary field, research context, methodological approach, theoretical underpinnings, and primary findings. This systematic extraction allowed for the identification of patterns, convergences, and gaps across the literature. The synthesis process was guided by the three theoretical lenses of spatial justice, critical pedagogy, and resilience thinking, with extracted data being organised thematically under these overarching frameworks. For example, literature on apartheid urban planning and contemporary climate vulnerability was analysed through the spatial justice lens; scholarship on student-centred, dialogical teaching methods was examined through the critical pedagogy lens; and studies on community adaptation and socio-ecological systems were interpreted through the resilience thinking lens. This theoretically informed thematic analysis enabled the study to move beyond a descriptive summary toward interpretive integration, revealing how insights from disparate fields could be woven together to construct a coherent pedagogical model.

The final stage of the methodology involved synthesising the extracted findings into a proposed pedagogical framework, which is presented in the current study's recommendations. This synthesis was not merely aggregative, but generative, identifying how the integration of GIS technology, historical content, and climate adaptation frameworks could be operationalised in South African classrooms. The PRISMA protocol ensured transparency throughout this process, with each stage identification, screening, eligibility, and inclusion documented to allow for critical appraisal and replication. By adhering to these rigorous procedures, the study provides a trustworthy foundation for its argument that GIS-based historical mapping, when linked to contemporary climate challenges, offers a powerful pathway for transformative, justice-oriented education. The methodology, thus, serves not only to answer the research question, but also as a model for how interdisciplinary synthesis can generate innovative responses to complex educational problems.

Screening: This stage involved the importation of 868 records into Rayyan, an AI-assisted systematic review platform that facilitates transparency and efficiency in the records screening processes (Blaizot et al. 2022). Firstly, 224 duplicate records that overlapped from the records across the seven databases were removed, generating 644 deduplicated records. The inclusion and exclusion stage followed, which ensured the alignment of the records with at least one of the study's major thematic areas of spatialised climate education/GIS

literacy; public sector capacity building in emerging economies, green public finance or climate-responsive fiscal governance, climate resilience or adaptive governance, and their relationships to African geographies. Hence, 387 unrelated records were expunged at this stage, yielding a corpus of 257 full-text records for eligibility evaluation. Ultimately, 75 articles were eligible for the study. Figure 4 depicts the PRISMA flow diagram adopted for the study.

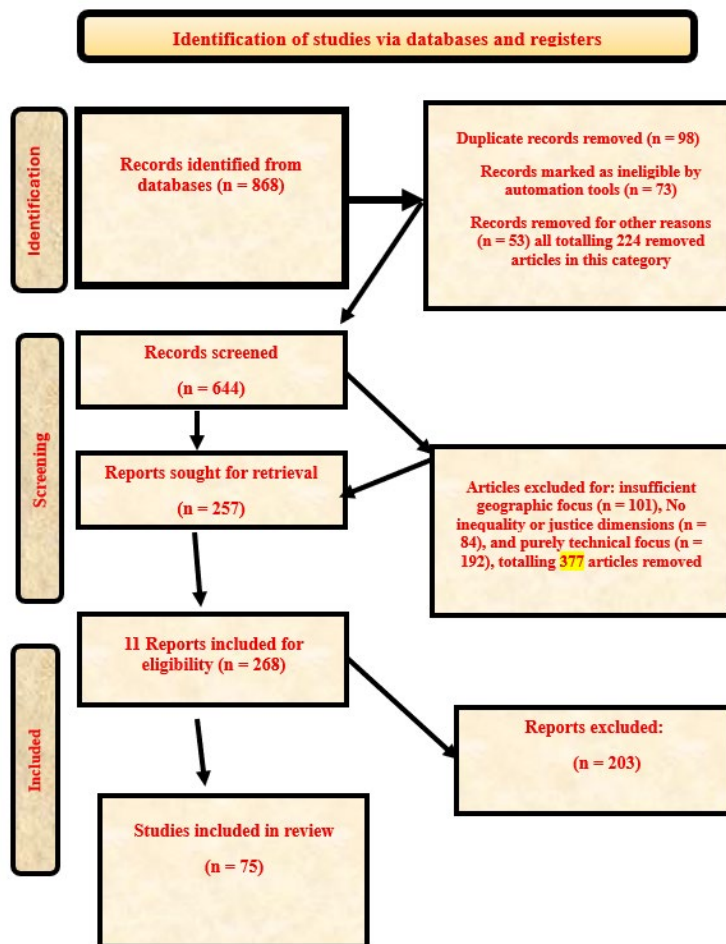


Figure 3: The SLR methodology adopted for the study using PRISMA protocols

Limitations of the study: Based on the SLR methodology of the current study, the research focused on synthesised secondary sources of literature; hence, the absence of classroom-based evidence. From the foregoing, empirical studies such as design-based research, action research, or quasi-experimental studies can be conducted to test the proposed pedagogical framework's effectiveness in actual educational settings.

Findings

Finding one: The persistent spatial legacies of apartheid create a pedagogical imperative for GIS integration

The first major finding emerging from the literature concerns the enduring material connections between apartheid-era spatial planning and contemporary climate vulnerability in South African townships. Scholarship in urban geography and South African history consistently demonstrates that the spatial logic of apartheid did not dissolve with the transition to democracy but rather became embedded in the built environment, continuing to shape patterns of risk, resource distribution, and resilience. Studies by Rogerson, as well as Todes and Houghton reveal that townships such as Soweto, designed as labour reserves with minimal infrastructure and situated on peripheries least desirable for white residential and commercial development, remain characterised by inadequate stormwater drainage, limited green space, and high-density informal settlements built on flood-prone or environmentally marginal land.^{20 21} These spatial characteristics, direct legacies of apartheid planning, now intersect with climate change projections indicating increased frequency of extreme rainfall events, heatwaves, and water scarcity in the Gauteng province, South Africa.²² What makes this finding significant for the present study is that multiple sources identify GIS as a uniquely powerful tool for making these spatial legacies visible to learners²³

²⁴. Soucy et al. argue that GIS enables students to move beyond abstract descriptions of

²⁰ CM Rogerson, "The economic development of South Africa's townships", J Knight and C Rogerson, *The geography of South Africa: Contemporary changes and new directions* (Cham: Springer International Publishing, 2018), pp. 187-194.

²¹ A Todes and J Houghton, "Economies and employment in growing and declining urban peripheries in South Africa", *Local Economy*, 36(5), 2021, pp. 391-410.

²² N Kambule, G Hoogendoorn, and G Visser, "'Bringing Sandton into Soweto': Perceptions of tourism-led gentrification in a South African township", *Tourism: An International Interdisciplinary Journal*, 72(2), 2024, pp. 131-146.

²³ J Hickman, "Spatial thinking and GIS: Developing and assessing student competencies", *International Research in Geographical and Environmental Education*, 32(2), 2023, pp. 140-158.

²⁴ JJ Kerski, "Teaching and learning geography with a Web GIS approach", A Klonari, ML De Lázaro y Torres and A Kizos, *Re-visioning geography: Supporting the SDGs in the post-COVID era* (Cham: Springer International Publishing, 2023), pp. 113-135.

historical injustice toward concrete, place-based understanding²⁵. When applied to the South African context, research by Bunting demonstrates that learners who engage with historical maps of the apartheid-era Soweto alongside contemporary satellite imagery and climate risk data, develop the capacity to 'read' their own environments as texts inscribed with histories of power and inequality.²⁶ The literature suggests that this spatial literacy is a form of critical consciousness, enabling learners to recognise that the flooding they witness in their communities during summer storms is not a natural phenomenon divorced from history^{27 28}, but a manifestation of decisions made decades ago about where Black South Africans would be permitted to live. This finding establishes the foundational rationale for GIS integration: the technology provides the means to visualise and interrogate the spatial continuity between past injustice and present vulnerability, transforming abstract historical knowledge into personally relevant, place-based understanding.²⁹³⁰

Finding two: Historical consciousness is deepened when learners trace continuities between past resistance and present challenges

The second finding concerns the relationship between historical pedagogy and the development of historical consciousness, that is, the understanding that the past is not a foreign country, but rather a living force that shapes present conditions and future possibilities^{31 32}. The reviewed literature reveals a consistent critique of conventional history teaching in South Africa, wherein the anti-apartheid struggle is often presented as

²⁵ AR Soucy, P Rahimzadeh-Bajgiran, S De Urioste-Stone, K Eitel, J Jansujwicz and M Brownlee, "Impact of a place-based educational approach on student and community members' experiences and learning within a post-secondary GIS course", *Journal of Geoscience Education*, 73(4), 2025, pp. 386-401.

Bunting, L., Gleghorne, N., Maguire, A., McKenna, S., & O'Reilly, D. 2024. Changing trends in child welfare inequalities in Northern Ireland. *The British Journal of Social Work*, 54(5), 1809-1829. <https://doi.org/10.1093/bjsw/bcad259>

²⁶ S Sanders, An investigation into the state of environmental education and the use of technology in environmental education in Gauteng, South Africa (Master's dissertation, University of Johannesburg, 2018).

²⁷ K Smith, CJ Fearnley, D Dixon, DK Bird and I Kelman, *Environmental hazards: Assessing risk and reducing disaster* (Routledge, 2023).

²⁸ M Favretti, *Learning in the age of climate disasters: Teacher and student empowerment beyond futurephobia* (Routledge, 2022).

²⁹ M Pavlovskaya, "Critical GIS as a tool for social transformation", *The Canadian Geographer/Le Géographe Canadien*, 62(1), 2018, pp. 40-54.

³⁰ SM Radil and MB Anderson, "Rethinking PGIS: Participatory or (post) political GIS?", *Progress in Human Geography*, 43(2), 2019, pp. 195-213.

³¹ A Clark and M Grever, "Historical consciousness: Conceptualizations and educational applications", *The Wiley International Handbook of History Teaching and Learning*, 2018, pp. 177-201.

³² N Popa, "Operationalizing historical consciousness: A review and synthesis of the literature on meaning making in historical learning", *Review of Educational Research*, 92(2), 2022, pp. 171-208.

a completed narrative with a triumphal endpoint in 1994.³³ Studies by Blair indicate that this narrative closure, while politically important in the immediate post-apartheid period, can inadvertently distance learners from the material by suggesting that the struggles of the past have been resolved and therefore, hold limited relevance for contemporary life³⁴. In contrast, research that explicitly connects historical events to ongoing spatial and environmental challenges demonstrates significantly deeper learner engagement and more nuanced historical understanding. A study by Gwala examining a pilot project in Soweto secondary schools found that when learners were guided to map the protest routes of 1976 alongside contemporary infrastructure deficits and climate vulnerabilities, they began to ask qualitatively different questions about history.³⁵ ³⁶ Rather than asking “*What happened on June 16, 1976?*” they began asking “*Why do the same areas that saw the fiercest protests still lack adequate drainage?*” and “*What would the students of 1976 think about how we are dealing with floods in our community today?*” These questions, the researchers argue, signal a shift from history as received knowledge to history as a resource for critical inquiry. The 1976 uprising ceased to be a static event confined to textbooks and became a living legacy with implications for understanding and acting upon present conditions. This finding is theoretically significant, because it demonstrates that integrating GIS and climate adaptation frameworks does not dilute historical understanding, but rather deepens it.³⁷ Learners come to appreciate the Soweto Uprising not merely as a moment of heroic resistance, but as an episode in a longer struggle for spatial justice that continues in new forms.³⁸ They recognise the young people of 1976 not as distant historical figures, but as predecessors whose strategies of organisation, communication, and collective action offer lessons for building community resilience in the face of climate threats. Historical consciousness, in this framing, becomes a resource for both understanding the present and imagining alternative futures.

³³ TW Corcoran, “*Reassessing the anti-apartheid struggle: An analysis of social inequality in South Africa through the theory of permanent revolution*” (Master’s thesis, San Diego State University, 2023).

³⁴ P Blair, “Hyper-compressions: The rise of flash fiction in ‘post-transitional’ South Africa”, *The Journal of Commonwealth Literature*, 55(1), 2020, pp. 38-60.

³⁵ MG Gwala, “*The role of school leadership in transforming township and rural schools in Gauteng Province, South Africa*” (Doctoral dissertation, University of South Africa, 2021).

³⁶ K Strong, “Do African lives matter to Black Lives Matter? Youth uprisings and the borders of solidarity”. *Urban Education*, 53(2), 2018, pp. 265-285.

³⁷ N Kauffman and K Hill, Climate change, adaptation planning and institutional integration: A literature review and framework. *Sustainability*, 13(19), p. 10708.

³⁸ J Seroto, “Analysing the presentation of the 1976 Soweto uprising...”, *Africa Education Review*, 15(4), 2018, pp. 1-19.

Finding three: GIS-based learning fosters spatial literacy and empowers earners as critical analysts

The third finding synthesises scholarship on the pedagogical applications of GIS, revealing that the technology, when deployed within a critical pedagogical framework, has the capacity to transform learners from passive recipients of spatial information into active producers of spatial knowledge and critics of spatial injustice.^{39 40} The literature distinguishes between two dominant approaches to GIS in education: a technical approach focused on software proficiency and data manipulation, and a critical approach that positions GIS as a tool for inquiry, analysis, and social critique. Studies by Monreal et al. and Banda argue that the latter approach, often termed “critical GIS”, aligns with the principles of critical pedagogy by democratising access to spatial data and enabling marginalised communities to produce counter-narratives that challenge official representations of space.⁴¹⁴² In the South African context, research by Nhamo et al. documents how participatory GIS was used to map flood risk in the Olifants Basin, drawing on both scientific data and local knowledge passed down through generations⁴³. This process not only built technical skills, it also fostered what the authors’ term “spatial agency”, the sense that learners could actively participate in shaping decisions about their environments rather than passively accepting conditions imposed by external authorities. Students presented their findings to local councillors, advocated for improved drainage infrastructure, and drew connections between historical patterns of underinvestment in Black areas and contemporary flood vulnerability. Extrapolating from these findings to the Soweto context, literature such as Nieves suggests that GIS-based mapping of the 1976 uprising would similarly empower learners to become critical analysts of their environments. By layering historical protest data onto contemporary climate vulnerability maps, learners would be positioned to ask whose voices were heard in 1976,

³⁹ J Holler, “Teaching critical open GIS”. *The Canadian Geographer/Le Géographe Canadien*, 64(4), 2020, pp. 484-494.

⁴⁰ ES Yoon, “Critical space analysis: Integrating geographic information systems into critical educational research”, MD Young and S Diem, *Handbook of critical education research* (Routledge, 2023), pp. 508-523

⁴¹ T Monreal, MR Deroo, and B Pitts, “Where we are: Reflecting on our use of critical mapping practices for spatial justice in teacher education”, *Social Studies Research and Practice*, 19(2), 2024, pp. 157-170.

⁴² R Banda, “Seeing the unseen: Critical geospatial mapping as a pedagogical tool to center the margins”. *International Journal of Multicultural Education*, 26(1), 2024, pp. 57-78.

⁴³ L Nhamo, J Magidi, J., S Mpandeli, O Mutanga, S Liphadzi and T Mabhaudhi, “Drought and flood risk mapping using a GIS-based multi-criteria decision method: A case of the Olifants Basin, South Africa”, *Next Sustainability*, 6, 2025, p. 100100.

AD Nieves, Engagements with Race, Memory, and the Built Environment in South Africa: A Case Study in Digital Humanities. In *The Routledge Companion to Media Studies and Digital Humanities* (pp. 391-402). Routledge. <https://doi.org/10.4324/9781315730479-41>

whose voices are heard today, and how spatial data might be used to advocate for more just and resilient communities.⁴⁴ The technology, in this framing, is a tool for reading the world by understanding the social, political, and economic forces that shape lived experience and acting upon that understanding in pursuit of transformation.

Finding four: Resilience thinking provides a bridge between historical memory and climate action, enabling future-oriented pedagogy

The fourth and most integrative finding concerns the role of resilience thinking in connecting historical understanding with contemporary action. The reviewed literature on climate change pedagogy reveals a persistent challenge: how to engage learners with the scale and urgency of climate threats without inducing despair, anxiety, or paralysis. Studies by Monroe et al. and Hung indicate that effective climate education must balance honest presentation of risks with opportunities for meaningful action, fostering constructive hope that individual and collective responses can make a difference.⁴⁵ ⁴⁶Resilience thinking, as articulated in the socio-ecological literature, offers a framework for achieving this balance. Rather than framing communities as passive victims of climate impacts, resilience thinking directs attention to adaptive capacities, historical experiences of overcoming adversity, and possibilities for transformation. Research by Ziervogel et al. on climate adaptation in African cities demonstrates that communities with strong histories of collective organisation and resistance to external pressures demonstrate greater adaptive capacity in the face of climate shocks⁴⁷. These historical experiences of resilience, the authors argue, are assets to be documented, celebrated, and mobilised in building capacity for future challenges.⁴⁸ The synthesis of literature across disciplines reveals that the Soweto Uprising represents precisely such a historical asset. The youth of 1976 demonstrated extraordinary resilience in the face of state violence, rapidly organising, communicating, and adapting

⁴⁴ TW Kenreich, "Rediscovering the local: Collaborative, community maps for civic awareness", EE Shin and SW Bednarz, *Spatial citizenship education* (Routledge, 2018), pp. 72-87.

⁴⁵ MC Monroe, RR Plate, A Oxarart, A Bowers and WA Chaves, "Identifying effective climate change education strategies: A systematic review of the research", *Environmental Education Research*, 25(6), 2019, pp. 791-812.

⁴⁶ CC Hung, *Climate change education: Knowing, doing and being* (Routledge, 2022).

⁴⁷ G Ziervogel, J Enqvist, L Metelerkamp and J Van Breda, "Supporting transformative climate adaptation: Community-level capacity building and knowledge co-creation in South Africa", *Climate Policy*, 22(5), 2022, pp. 607-622.

⁴⁸ W Leal Filho, AL Balogun, DY Ayal, EM Bethurem, M Murambadoro, J Mambo, H Taddese, GW Tefera, GJ Nagy, H Fudjumdjum, and P Mugabe, "Strengthening climate change adaptation capacity in Africa: case studies from six major African cities and policy implications", *Environmental Science & Policy*, 86, 2018, pp. 29-37.

their strategies in response to changing circumstances. Their example offers contemporary learners a powerful model of what collective action in the face of overwhelming odds can achieve. When this historical resilience is explicitly linked to contemporary climate challenges through GIS-based pedagogy, learners are positioned to draw lessons from the past and apply them to the present.⁴⁹ Learners can ask: What enabled young people in 1976 to organise so effectively? How did they communicate across the township? How did they sustain hope and commitment in the face of brutal repression? And how might these strategies inform community-based climate adaptation today?

Research by Giroux on transformative, transgressive learning in environmental education suggests that such connections between historical struggle and contemporary resilience are pedagogically powerful, since they position learners as inheritors of a legacy of resistance and agents of future transformation⁵⁰. Rather than approaching climate change as a new and unprecedented crisis requiring entirely novel responses, learners can draw on the deep well of community knowledge, collective memory, and historical resilience that their own communities embody. The GIS mapping exercise becomes, in this context, a set of strategies for survival, resistance, and resilience that have been passed down through generations. Taken together, these four findings provide a coherent evidence base for the proposed pedagogical model. The literature demonstrates that the spatial legacies of apartheid create an urgent need for teaching approaches that make visible the connections between past and present, and that GIS technology offers uniquely powerful tools for meeting this need. It reveals that historical consciousness deepens, not dilutes, when learners trace continuities between historical resistance and contemporary challenges, and that GIS-based learning fosters spatial literacy and has the potential to empower learners as critical analysts of their environments. Finally, it establishes that resilience thinking provides the conceptual bridge between historical memory and climate action, enabling a future-oriented pedagogy that honours the past while building capacity to address the challenges ahead. The convergence of evidence across multiple disciplines suggests that integrating GIS-based historical mapping with climate change adaptation frameworks is not merely a novel pedagogical innovation, but a theoretically grounded, empirically supported approach to transformative education. It addresses the identified problem of historical sequestration by positioning the Soweto Uprising as a living legacy with direct implications for understanding and acting upon contemporary spatial and environmental

⁴⁹ M Pamuk, “*Teaching geographical thinking with GIS-based projects: Learning from experienced teachers’ perspectives*” (Doctoral thesis, The Florida State University, 2023).

⁵⁰ HA Giroux, *Theory and resistance in education: Towards a pedagogy for the opposition* (2024).

injustices. It responds to the urgent need for climate change education that fosters agency rather than despair by connecting learners to histories of resilience that demonstrate the possibility of collective action in the face of overwhelming odds. And it advances the broader project of decolonising education by centring the knowledge, experiences, and strategies of Black South African communities as resources for building just and sustainable futures. The findings thus answer the research question by demonstrating that GIS-based historical mapping, when linked to contemporary climate vulnerability and framed by spatial justice theory, critical pedagogy, and resilience thinking, fosters spatial literacy, deepens historical consciousness, and cultivates the adaptive and transformative capacities that resilience requires. They provide the evidentiary foundation for the study's recommendations regarding curriculum development, teacher professional development, and further research, while also contributing to broader scholarly conversations about the role of digital humanities in education, the spatial dimensions of historical memory, and the pedagogical possibilities of connecting past and present struggles for justice.

Discussion

The findings of this study invite a sustained and critical discussion of the possibilities, tensions, and implications of integrating GIS-based historical mapping into climate change adaptation frameworks for teaching the 1976 Soweto Uprising. This discussion engages with the four findings in turn, situating them within broader scholarly debates, drawing comparisons with international contexts, and critically examining the challenges and limitations that accompany the proposed pedagogical approach. The discussion goes beyond interpreting the findings to interrogating them, acknowledging the complexities and contestations that any attempt to bridge historical memory and climate action must confront.

The spatial legacies of apartheid: A South African specificity or a global phenomenon?

The first finding, concerning the persistent spatial legacies of apartheid and the pedagogical imperative they create, raises important questions about the specificity of the South African case and its relevance to broader international conversations about spatial justice education. Critics might argue that apartheid was a unique historical formation, so extreme in its spatial engineering that comparisons with other contexts are necessarily limited. However, literature suggests that while the intensity of apartheid-era spatial planning may be distinctive, the underlying phenomenon, the production of durable spatial inequalities

through state policy is depressingly common across the globe. Consider the case of the United States, where redlining practices codified by the Homeowners' Loan Corporation in the 1930s systematically denied mortgage insurance to predominantly Black neighbourhoods, creating patterns of disinvestment and environmental injustice that persist nearly a century later. Research by Melgaço et al. demonstrates that these explicitly racialised spatial policies produced urban geographies strikingly similar to those of South African townships: Black communities concentrated on less desirable land, adjacent to industrial pollution, lacking green space and adequate infrastructure, and disproportionately vulnerable to flooding and extreme heat.⁵¹ When Hurricane Katrina devastated New Orleans in 2005, the devastation was not randomly distributed, but concentrated in historically Black neighbourhoods built on the most flood-prone land, a spatial pattern directly traceable to decades of racist housing policy.^{52,53} Mohai and Bryant term this phenomenon "environmental racism", arguing that the unequal distribution of environmental risks is not accidental, but is produced and reproduced through spatial decisions that privilege white communities at the expense of Black and brown communities.⁵⁴

Similarly, in Brazil, the legacy of colonial and post-colonial spatial planning has produced favelas perched on hillsides and mangrove swamps, the least desirable land, most vulnerable to landslides and flooding—while wealthier Brazilians occupy safer, more desirable terrain.^{55,56} Nemer demonstrates that these spatial patterns are deeply racialised, reflecting the continued marginalisation of Afro-Brazilian communities long after formal slavery ended.⁵⁷ When devastating landslides struck the Rio de Janeiro region in recent years, the fatalities were overwhelmingly concentrated in favela communities whose spatial vulnerability was centuries in the making. These international parallels suggest

⁵¹ L Melgaço and L Xavier Pinto Coelho, "Race and space in the post-colony: A relational study on urban planning under racial capitalism in Brazil and South Africa", *City & Community*, 21(3), 2022, pp. 214-237.

⁵² KE Caldwell, "*The Katrina moment: Rethinking disaster with Black geographies*" (Doctoral dissertation, University of Wisconsin, 2021).

⁵³ MI Daep and JW Hsu, "The effect of racial composition on neighbourhood housing prices: Evidence from hurricane Katrina-induced migration", *Journal of Urban Economics*, 134, 2023, p. 103515.

⁵⁴ P Mohai and B Bryant, "Environmental racism: Reviewing the evidence", B Bryant and P Mohai, *Race and the incidence of environmental hazards* (Routledge, 2019), pp. 176-163.

⁵⁵ F Ferretti, "Decolonizing regional planning from the Global South: Active geographies and social struggles in Northeastern Brazil", *Environment and Planning D: Society and Space*, 39(4), 2021, pp. 665-684.

⁵⁶ A Davies, "Landscape semaphore: Seeing mud and mangroves in the Brazilian Northeast", *Transactions of the Institute of British Geographers*, 46(3), 2021, pp. 626-641.

⁵⁷ D Nemer, *Technology of the oppressed: Inequity and the digital mundane in favelas of Brazil*, (MIT Press, 2022).

that the pedagogical approach proposed in this study, while grounded in the specific history of Soweto, has potential applicability far beyond South Africa. The core insight, that historical spatial injustices can be mapped and connected to contemporary climate vulnerability resonates across contexts where communities of colour bear disproportionate environmental burdens. What differs is the specific historical narrative that provides the entry point: in the United States, it might be the Great Migration, redlining, or the Civil Rights movement's spatial strategies; in Brazil, it might be quilombo communities, abolition, or contemporary favela resistance movements. The theoretical framework of spatial justice, critical pedagogy, and resilience thinking travels across these contexts, providing a portable analytical lens even as the specific content must be locally grounded. However, this very portability raises a cautionary note. Scholars such as Brown, as well as Brett and Guyver, warn against what they term "settler moves to innocence", the tendency to appropriate Indigenous and minoritised histories for educational purposes without attending to ongoing structures of dispossession and violence.^{58,59} In adapting the Soweto model to other contexts, educators must be vigilant against superficial comparisons that elide important differences and risk reducing complex historical experiences to interchangeable examples of 'oppression'. The specificity of apartheid, including its particular fusion of racial capitalism, Afrikaner nationalism, and Cold War geopolitics, must not be erased in the service of comparative pedagogy. Rather, each context requires its own deep historical grounding, its own engagement with local memories and struggles, and its own careful theorisation of how spatial justice applies.

Deepening historical consciousness: The tension between memory and utility

The second finding, that historical consciousness is deepened when learners trace continuities between past resistance and present challenges, engages a robust debate within history education regarding the purposes and dangers of 'presentist' approaches to teaching the past. Critics of connecting history to contemporary issues argue that such approaches risk instrumentalising the past, reducing complex historical events to simplistic lessons for the present, and imposing contemporary categories and concerns onto historical actors who cannot speak back. Lévesque and Croteau warn that "the past is a foreign country" with its own logic, values, and constraints, and that efforts to make it relevant risk distorting

⁵⁸ L Brown, "Indigenous young people, disadvantage and the violence of settler colonial education policy and curriculum" *Journal of Sociology*, 55(1), 2019, pp. 54-71.

⁵⁹ P Brett and R Guyver, Postcolonial history education: Issues, tensions and opportunities, *Historical Encounters: A Journal of Historical Consciousness, Historical Cultures and Historical Education*, 8(2), 2021, pp. 1-17.

it beyond recognition.⁶⁰ From this perspective, teaching the Soweto Uprising primarily as a lesson for climate adaptation might diminish its specificity, reducing the brave students who faced police bullets to mere precursors of climate activists and erasing the particularity of their anti-apartheid struggle. Proponents of connecting history to contemporary issues offer a robust response. Popa argues that historical consciousness necessarily involves a dialogical relationship between past and present, wherein contemporary concerns are brought to the study of history and allow history to challenge and refine those concerns.⁶¹ The goal is not to collapse past into present, but to create a productive tension wherein each illuminates the other. When learners ask what the students of 1976 might think about contemporary climate vulnerability, they are not imposing present categories onto the past, they are engaging in the kind of imaginative historical thinking that recognises historical actors as fully human agents whose experiences and strategies might speak across time, even as their specific context remains distinct.

International comparisons enrich this debate. In Germany, the teaching of the Holocaust has long grappled with the tension between historical specificity and contemporary relevance. Scholars such as Gross and Gläser et al. document how German educators navigate the challenge of teaching this singular event while also drawing connections to contemporary racism, antisemitism, and extreme right violence.^{62, 63} The authors' research suggests that the most effective approaches neither treat the Holocaust as an incomparable aberration that offers no lessons for the present, nor does it reduce it to a generic warning about prejudice that erases its specificity. Rather, they create pedagogical spaces wherein students can hold both the uniqueness and the resonance of the event simultaneously, recognising that the Holocaust was historically specific, while also acknowledging that the human capacities it revealed for hatred, indifference, courage, and resistance remain active in the world. Similar debates animate the teaching of colonialism and slavery in former imperial powers. In Britain, arguments rage over whether the history of the British Empire should be taught as a source of national pride, as a catalogue of crimes, or as a complex phenomenon with both beneficial and harmful effects. Scholars such as Rajan argue for approaches that connect colonial history to contemporary racial inequalities and migration

⁶⁰ S Lévesque and JP Croteau, *Beyond history for historical consciousness: Students, narrative, and memory*, (University of Toronto Press, 2020).

⁶¹ N Popa, "Operationalizing historical consciousness: A review and synthesis of the literature on meaning making in historical learning", *Review of Educational Research*, 92(2), 2022, pp. 171-208.

⁶² Z Gross, "The process of the universalization of Holocaust education: Problems and challenges", *Contemporary Jewry*, 38(1), 2018, pp. 5-20.

⁶³ G Gläser, G Hentges, and M Meier, "Implementing antisemitism studies in German teacher education", *Journal of Social Science Education*, 20(3), 2021, pp. 75-101.

debates, while critics warn against imposing present-day moral judgments on past actors.⁶⁴ The Soweto case, situated within this broader conversation, suggests that the most pedagogically powerful approaches are those that refuse simplistic either/or positions. The uprising was a specific event with particular causes and consequences; it was also an expression of youthful resistance to spatial oppression that resonates with contemporary struggles for environmental justice. Holding both truths simultaneously is the work of sophisticated historical thinking, not its abandonment.

GIS and critical pedagogy: Technology as liberation or surveillance?

The third finding, concerning GIS-based learning as a tool for empowerment and spatial literacy, must be situated within a vigorous debate about the politics of technology in educational contexts. Proponents of GIS in education, represented in the reviewed literature by scholars such as Kerski and DeMers et al., celebrate its capacity to democratise spatial data, enable student inquiry, and foster critical thinking.^{65,66} However, critics within the critical GIS community raise important cautions about the assumptions embedded in the technology itself and the contexts of its deployment. Chipatso and Joos have argued that GIS is not a neutral tool, but a technology with a particular genealogy, embedded in military mapping, state surveillance, and corporate data extraction.^{67,68} The very categories through which GIS organises the world in layers, attributes, and coordinates, reflect particular ways of knowing that may marginalise Indigenous or local knowledges that do not conform to Western spatial epistemologies. When students map Soweto using GIS, they are not simply representing reality, but constructing it in accordance with the software's logic. What gets left out? How do we map memory, feeling, oral tradition, or spiritual significance—all central to the experience of 1976—in a system designed for points, lines, and polygons? These concerns are amplified when considering the data politics of GIS in contemporary South Africa. Who owns the spatial data students use? Who controls the satellite imagery? What happens to the maps students create, do they become the property

⁶⁴ SI Rajan, *India migration report 2021: Migrants and health*, (Routledge India, 2022).

⁶⁵ JJ Kerski, "Integrating web mapping and geospatial technologies", M Solem, K Foote, S O'Lear, L-T Eaves, and J Lee, *Thriving in an academic career* (Routledge, 2024), pp. 189-174.

⁶⁶ MN DeMers, JJ Kerski, and CJ Sroka, "The teachers teaching teachers GIS institute: Assessing the effectiveness of a GIS professional development institute", *Annals of the American Association of Geographers*, 111(4), 2021, pp. 1160-1182.

⁶⁷ E Chipatso, "Application of GIS and artificial intelligence in military operations: Prospects and challenges", *Southern African Journal of Security*, 3, 2025, pp. 1-17.

⁶⁸ G Joos, "Geographic information systems in defence", W Kresse and D Danko, *Springer handbook of geographic information* (Cham: Springer International Publishing, 2022), pp. 705-685.

of the school, the department of education, or a corporate technology provider? Scholars such as Redden and Aleman warn of neoliberal datafication, wherein participatory mapping projects, however well-intentioned, ultimately feed data into systems that may be used for surveillance, discipline, or to profit from the very communities they aim to empower.^{69,70} In a country with deep histories of state surveillance of Black communities, these concerns are not abstract but urgently material.

International comparisons with Indigenous mapping projects offer instructive lessons. In Canada, researchers and Indigenous communities have developed protocols for ‘counter-mapping’ that explicitly address these power dynamics. Studies by Thapa and Thompson document how indigenous communities use GIS to document traditional territories, assert land claims, and resist resource extraction, however, always on terms set by the communities themselves, with strict controls over data ownership, access, and use.⁷¹ These projects demonstrate that GIS can be a tool for liberation, but only when its use is accompanied by critical consciousness about its limitations and dangers. Applied to the Soweto context, this suggests that student mapping must be accompanied by explicit teaching about the politics of spatial data, the history of surveillance in South Africa, and the importance of community control over representations of community space.

Resilience thinking: Empowerment or burden shifting?

The fourth finding, concerning resilience thinking as a bridge between historical memory and climate action, engages perhaps the most contentious debate in contemporary climate change scholarship: the politics of resilience as a concept. Proponents, including many scholars in the socio-ecological systems tradition, celebrate resilience thinking for its emphasis on adaptive capacity, community strengths, and possibilities for transformation. Critics, however, argue that the resilience framework has been co-opted by neoliberal governance regimes that use it to justify withdrawing state support and shifting responsibility for coping with crisis onto already marginalised communities. Ferguson offers a sharp critique, arguing that the celebration of resilience in contemporary policy

⁶⁹ J Redden, “Democratic governance in an age of datafication: Lessons from mapping government discourses and practices”, *Big Data & Society*, 5(2), 2018, p. 2053951718809145.

⁷⁰ E Aleman, “Exploring alternative discourses about datafication in a speculative youth participatory action research curriculum”, *Information and Learning Sciences*, 125(3-4), 2024, pp. 190-208.

⁷¹ K Thapa and S Thompson, Applying density and hotspot analysis for indigenous traditional land use: Counter-mapping with wasagamack first nation, Manitoba, Canada”, *Journal of Geoscience and Environment Protection*, 8(10), 2020, pp. 285-313.

discourse represents a profound abandonment of the modern promise of security.⁷² When communities are told to be resilient in the face of climate change, the implicit message is that the state cannot or will not protect them, that they must absorb shocks and adapt on their own. From this perspective, teaching Soweto learners to be ‘resilient’ in the face of climate threats risks echoing the very logic of apartheid-era governance, wherein Black communities were expected to cope with minimal resources while the state directed its investments elsewhere. The students of 1976 were not celebrated for their resilience; they were demanding that the state be held accountable for its violence and neglect. Resilience, in this critique, becomes a depoliticising concept that directs attention away from the structural causes of vulnerability and toward the adaptive capacities of the vulnerable.

Defenders of resilience thinking offer a nuanced response. Boillat and Bottazzi acknowledge the concept’s co-optation, however, argue that it retains critical potential when understood in its original socio-ecological sense.⁷³ Resilience is not merely about coping, but about transformation, the capacity to create fundamentally new systems when old ones prove untenable. The students of 1976 were not simply coping with apartheid; they were building a movement capable of transforming the entire political order. This transformative resilience, far from depoliticising struggle, represents its highest expression. The challenge for educators is to ensure that resilience is taught in this transformative sense, not as passive adaptation, but as active struggle for structural change. International comparisons with post-disaster recovery efforts illuminate this tension. Following Hurricane Maria in Puerto Rico, communities organised mutual aid networks that provided food, water, and medical care when the state and federal governments failed to respond.⁷⁴ Scholars such as Delilah-Roque et al. document how these efforts were celebrated as examples of community resilience while also serving to mask the colonial abandonment that created the conditions of vulnerability in the first place.⁷⁵ The most critical analyses argue that genuine resilience requires both community organising and structural transformation—the rebuilding of infrastructure, the restoration of electricity grids, the provision of adequate housing—that

⁷² P Ferguson, “Discourses of resilience in the climate security debate”, *Global Environmental Politics*, 19(2), 2019, pp. 104-126.

⁷³ S Boillat and P Bottazzi, “Agroecology as a pathway to resilience justice: Peasant movements and collective action in the Niayes coastal region of Senegal”, *International Journal of Sustainable Development & World Ecology*, 27(7), 2020, pp. 662-677.

⁷⁴ A Chandra, T Marsh, J Madrigano, MM Simmons, M Abir, EW Chan, J Ryan, N Nanda, MD Ziegler, and C Nelson, “Health and social services in Puerto Rico before and after Hurricane Maria: Predisaster conditions, hurricane damage, and themes for recovery”, *Rand Health Quarterly*, 9(2), 2021, p. 10.

⁷⁵ A Delilah-Roque, D Pijawka, and A Wutich, “The role of social capital in resiliency: Disaster recovery in Puerto Rico”, *Risk, Hazards & Crisis in Public Policy*, 11(2), 2020, pp. 204-235.

only state action can provide. Applied to Soweto, this suggests that teaching resilience must be accompanied by teaching accountability: learners should understand not only their own capacities for collective action, but also the responsibilities of the state to provide the conditions in which resilience is possible.

Implications for policy and practice

These debates carry significant implications for the implementation of the proposed pedagogical model. First, they suggest that teacher professional development must be substantially more sophisticated than mere technical training in GIS software. Teachers need opportunities to grapple with the theoretical debates outlined above, to develop their own critical perspectives on spatial justice, technology politics, and resilience discourse, and to design pedagogical approaches that navigate these complexities with integrity. This requires time, resources, and sustained engagement that current professional development models rarely provide. Second, the debates highlight the importance of community engagement in the design and implementation of GIS mapping projects. If the maps students create are to genuinely serve community interests rather than extract community data, protocols must be established for community ownership, control, and benefit. This might involve partnerships with community organisations, advisory boards comprising elders and activists, and explicit agreements about how maps can and cannot be used. The goal should be not merely student learning, but genuine community empowerment, wherein the mapping process builds capacity for collective action on spatial and environmental justice.

Third, the debates underscore the need for curriculum materials that present multiple perspectives on the connections between past and present. Rather than offering a single narrative about what the Soweto Uprising ‘teaches’ us about climate adaptation, educators should present students with competing interpretations, encouraging them to weigh evidence, consider alternative viewpoints, and develop their own reasoned positions. The classroom should become a space of genuine intellectual contestation, wherein students debate the politics of memory, the uses of history, and the meanings of resilience. Finally, these debates suggest important directions for future research. Longitudinal studies are needed to track how students who experience this integrated pedagogy think about history, space, and climate over time. Comparative studies across different South African contexts—urban and rural, wealthy and poor, coastal and inland—would illuminate how the model must be adapted for different settings. International comparative research,

systematically examining similar pedagogical initiatives in other post-colonial and post-conflict societies, would test the portability of the framework, while also revealing context-specific adaptations.

Conclusion: Productive tensions and the path forward

It is imperative to state that the pedagogical conclusions are theoretical propositions derived from the literature synthesis rather than findings from original empirical research. The discussion reveals that the proposed integration of GIS-based historical mapping with climate change adaptation frameworks is not a settled proposition, but a site of productive tension. The spatial legacies of apartheid are both specific to South Africa and resonant with global patterns of environmental racism. Deepening historical consciousness through present connections risks presentism, but also enables genuine historical thinking. GIS technology offers tools for empowerment while also carrying risks of surveillance and data extraction. Resilience thinking can inspire transformative action, however, can also serve to the shift burden onto the vulnerable. These tensions are not weaknesses to be resolved, but features to be embraced. A mature pedagogical approach does not pretend to offer simple answers to complex questions, but rather creates spaces wherein learners can grapple with complexity, hold multiple perspectives in productive tension, and develop their own reasoned positions. The students of 1976 did not have the luxury of such nuanced deliberation; they faced immediate, violent oppression and responded with courage and clarity. Contemporary learners, inheriting both their legacy and the new challenges of climate change, deserve an education that honours that clarity while also preparing them for a world in which the connections between past and present, resistance and resilience, are rarely simple. The path forward lies in sustained, critical engagement with these debates, in genuine partnership with communities, and in unwavering commitment to the transformative potential of education. The proposed model, for all its complexities and tensions, offers a way of teaching the Soweto Uprising that refuses to let it become a museum piece, insisting instead that the struggle for spatial justice continues and that the young people of today, like those of 1976, have a vital role to play.

Recommendations

Recommendations for curriculum development and policy

The first set of recommendations concerns the formal curriculum and the policy frameworks that shape what is taught in South African schools. The findings demonstrate

that current approaches to teaching the Soweto Uprising, while valuable, fail to leverage the full pedagogical potential of the event by treating it as a discrete historical moment disconnected from contemporary spatial and environmental realities. It is, therefore, recommended that the Curriculum and Assessment Policy Statement (CAPS) for history be revised to explicitly articulate connections between historical events and contemporary spatial justice issues, including climate change adaptation. This revision should not take the form of adding new content to an already overcrowded curriculum, but rather of reconceptualising how existing content is framed and taught. The Soweto Uprising, already mandated content in the Grade 12 curriculum, could be taught through an expanded lens that includes attention to the spatial dimensions of apartheid planning, the enduring legacies of that planning in contemporary Soweto, and the intersection of these legacies with climate vulnerability. Furthermore, it is recommended that the curriculum create explicit space for interdisciplinary collaboration between History, Geography, and Life Orientation. The proposed pedagogical model inherently crosses disciplinary boundaries, requiring historical knowledge, geographical skills, and the critical consciousness central to Life Orientation's focus on citizenship and social justice. Current curriculum structures, with their rigid subject boundaries and separate assessment frameworks, actively discourage such interdisciplinary work. Policy revisions should, therefore, encourage or require schools to allocate time for cross-disciplinary projects, with assessment frameworks that can accommodate integrated, project-based learning outcomes. This might involve developing new subject classifications, such as 'Humanities Inquiry' or 'Social and Environmental Studies', or creating dedicated time in the school timetable for extended projects that draw on multiple disciplines.

Curriculum developers should also prioritise the development of locally relevant, place-based materials that support the proposed pedagogical approach. While national curricula provide necessary consistency, the power of the GIS mapping model lies in its attention to local specificities—the particular streets, landmarks, and environmental vulnerabilities of individual communities. National curriculum materials should therefore be designed with flexibility that allows for local adaptation, and provincial and district education authorities should be resourced to support schools in developing place-based materials that connect national historical narratives to local geographies. In Soweto, this might involve partnerships with the Soweto Heritage Trust, the Hector Pieterse Memorial, and local museums to develop materials that draw on community knowledge and memory while also incorporating contemporary climate data.

Recommendations for teacher professional development

The findings and discussion make it abundantly clear that the successful implementation of the proposed pedagogical model depends fundamentally on teacher capacity. Teachers cannot be expected to facilitate sophisticated GIS-based historical inquiry that engages with spatial justice theory, critical pedagogy, and resilience thinking without substantial, sustained professional development support. It is, therefore, recommended that teacher education institutions, both pre-service and in-service, develop comprehensive programmes that address the multiple dimensions of this approach. First, teachers need technical training in GIS and geospatial technologies. The findings indicate that GIS is a powerful tool for making spatial connections visible, however, this power is realised only when teachers are confident and competent in using the technology themselves. Professional development should, therefore, include hands-on training in accessible GIS platforms such as ArcGIS Online, QGIS, or Google Earth Engine, with attention to both the technical skills of data manipulation and the pedagogical skills of guiding student inquiry. This training should be ongoing, recognising that technology evolves rapidly and that teachers need sustained support rather than once-off workshops. Second, and equally important, teachers need deep engagement with the theoretical frameworks underpinning the approach. The discussion revealed significant debates about the politics of spatial justice, the dangers of presentism in history teaching, the surveillance potentials of GIS technology, and the contested meanings of resilience. Teachers cannot navigate these complexities with students unless they have grappled with them themselves. Professional development should therefore include structured opportunities for teachers to read, discuss, and debate the relevant scholarship, to develop their own critical perspectives, and to consider how these debates manifest in their specific teaching contexts. This might involve book study groups, participation in academic conferences, or partnerships with university researchers who can facilitate theoretical engagement.

Third, teachers need pedagogical support in designing and facilitating inquiry-based, project-oriented learning. The proposed model departs significantly from transmission-based teaching, positioning students as active inquirers who formulate questions, gather and analyse data, and construct their own understandings. Many teachers have limited experience with this pedagogical approach and may lack confidence in facilitating open-ended inquiry where outcomes are not predetermined. Professional development should, therefore, model inquiry-based pedagogy, provide structured frameworks for designing projects, and create opportunities for teachers to share experiences and learn from one

another's successes and challenges. Fourth, teachers need support in navigating the emotional dimensions of this work. Teaching about the Soweto Uprising inevitably engages with trauma, violence, and loss. Adding climate change, with its attendant anxieties about an uncertain future, compounds the emotional complexity. The discussion noted the risk of inducing despair or anxiety, and the importance of fostering constructive hope. Teachers need preparation in facilitating difficult conversations, supporting students' emotional responses, and creating classroom environments where vulnerability can be expressed without overwhelming learners. This might involve collaboration with school counsellors, training in trauma-informed pedagogy, and attention to teachers' own emotional wellbeing as they engage with these challenging topics.

Recommendations for technology development and access

The proposed pedagogical model depends on access to GIS technology, which raises significant equity concerns in a country with deep digital divides. Consequently, it is recommended that the Department of Basic Education, in partnership with provincial education departments and private sector partners, invest substantially in expanding access to digital technologies in historically disadvantaged schools. This includes not only hardware computers, tablets, reliable internet connectivity, but also software, technical support, and ongoing maintenance. Without such investment, the proposed approach risks benefiting only already privileged schools, thereby exacerbating rather than reducing educational inequality. Beyond access, there is a need for the development of locally relevant digital resources. International GIS platforms come pre-loaded with data sets that reflect Northern priorities and perspectives. South African learners need access to high-quality, locally produced spatial data, including historical maps of apartheid-era townships, contemporary climate vulnerability data, and community-generated data that captures local knowledges and experiences. It is recommended that the Department of Science and Innovation, working with universities and research councils, prioritise the development of open-access spatial data infrastructures that serve educational as well as research purposes.

Limitations and future research directions

This study acknowledges the absence of classroom-based evidence, hence, for future empirical studies such as design-based research, action research, or quasi-experimental studies, studies can be conducted to test the proposed pedagogical framework's effectiveness in actual educational settings.

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