



# Integrating Global Epistemology and Local Action: The OONAR "Local Climate Detectives" Learning Model in Realizing Community Ecological Justice in Elementary Schools

Meirza Nanda Faradita<sup>1</sup>, Ganes Gunansyah<sup>2\*</sup>, Neni Mariana<sup>2</sup>

<sup>1</sup>Fakultas Komunikasi, Pendidikan dan Sains, Universitas Muhammadiyah Surabaya, Indonesia.

<sup>2</sup>Fakultas Ilmu Pendidikan, Universitas Negeri Surabaya, Indonesia.

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Corresponding Author:

Ganes Gunansyah

[ganesgunansyah@unesa.ac.id](mailto:ganesgunansyah@unesa.ac.id)

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**Abstract:** This study proposes a pedagogical model, "Local Climate Detectives," to integrate global epistemology with students' local experiences in primary science education. The study addresses the gap between universal scientific knowledge and contextual learning in responding to climate change challenges (SDG 13). A qualitative conceptual approach was employed through a systematic literature review, guided by Robertson's Glocalization framework. The analysis focused on the mechanisms of interpenetration and mutual shaping between global and local knowledge systems. The result of this study is a theoretical construction of the OONAR learning model (Orientation-Observation-Negotiation-Action-Reflection) as an operational framework for glocal learning. Within this model, the Correlation Reasoning stage is positioned as a key epistemic process that connects locally generated data (e.g., environmental observations) with global scientific references. This integration is designed to foster resilient ecological reasoning and support collective decision-making grounded in local socio-cultural values. The study concludes that the proposed model provides a coherent framework for developing students' climate literacy and glocal identity, positioning them as active contributors to community-based ecological justice.

**Keywords:** Community ecological justice; Elementary school; Glocalization; The OONAR local climate detectives

## Introduction

Education plays a fundamental role as a process of transferring knowledge, culture, and values. This function ensures that the younger generation not only acquires technical knowledge and skills, but also inherits noble values, local wisdom, and collective awareness that shape the identity of the nation (Indartiningsih et al., 2023). In facing the challenges of the 21st century, education must be adaptive to the tide of globalization, where global issues demand contextual responses. The greatest challenge today is the global climate change crisis, which is the main focus of Sustainable Development Goal (SDG) 13 and requires collective action and a deep scientific understanding (Monroe et

al., 2019). IPAS learning in a global and local context at primary school level plays a vital role in internalizing these global issues. To achieve meaningful learning, IPAS learning must integrate two poles of knowledge, namely Global Context (Universal). IPAS learning has an obligation to introduce universal scientific concepts, such as the greenhouse effect, carbon cycle, and global warming. This knowledge is reinforced through access to and comparison of scientific data from international networks (e.g. NASA, UNEP) with the aim of fostering Climate Literacy and Global Citizenship Education. Local Context (Particular) (Ridho et al., 2025). This global knowledge must be grounded through direct observation of the ecological realities surrounding students. Issues such as changes in local weather

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patterns, flooding, and plastic waste management become starting points for students to conduct scientific observation and inquiry (Kirchhoff et al., 2015).

Glocalization has emerged as an effective pedagogical strategy for bridging these two poles, whereby global scientific understanding is translated contextually and meaningfully at the local level (Rumanta et al., 2025). Glocalization, when linked to the suitability of the project with the concept of "Local Climate Detectives", is very much in line with Robertson's Theory of Glocalization, which defines Glocalization as a process of interpenetration and hybridization between global values and local contexts, where the global does not replace the local, but rather both mutually shape each other. This concept emphasizes "the simultaneity of the universal and the particular" (Robertson, 1995). The "Local Climate Detectives" project is a concrete manifestation of this theory because students learn global climate concepts (universal) but relate them to local realities and data (particular). Learning shows that global scientific knowledge becomes meaningful because it is interpreted and lived locally (Supranartha et al., 2025). This two-way interaction, from NASA data to school pages, produces contextual and reflective understanding (and vice versa).

Ecopedagogy extends Freire's critical perspective to the environmental realm. This theory views education not simply as the transfer of information, but as a tool for achieving ecological justice. The emphasis on "creative resistance" to hegemonic Western science encourages students to become ecologically conscious agents of change (Misiasek, 2025). Learning must also be rooted in local characteristics such as culture, environment, and economics as a foundation for understanding broader issues. Sobel (2004) argues that by loving and understanding their own "backyard," students will be more motivated to care for the earth as a whole. This aligns perfectly with the concept of "Local Climate Detectives." Crawford (2000) states that effective science learning must be authentic and inquiry-based. Your climate detective project is a concrete example of empowering students to become young scientists who not only memorize NASA data but also conduct empirical verification in the field.

In traditional science education, there is often a gap between abstract scientific concepts and the real-life experiences of students (Nurbaya et al., 2025). In addition, the curriculum is prone to the hegemony of modern or Western science (Scientific Colonization), in which uniform global models and data are taught without considering the diversity of local wisdom and ecological realities (Sulartini et al., 2026). This project addresses this gap by directing students to compare local data with global data, so that global knowledge is

given new meaning by the local context. The next step is to encourage local action (sorting waste, reforestation) as a practical implementation of global goals (SDG 13), which can also be seen as "creative resistance" to the homogenization of science globalization. This research was conducted to bridge the abstraction gap in climate change material, which is often considered too distant from the daily lives of elementary school students. Second, this research is useful for building data-based climate literacy by training students to validate global information through empirical observation. Third, there is a need to promote global learning models as a practical solution to overcome the saturation of overly theoretical curricula.

From the background explanation above, it can be described that the purpose of this study is to analyze the implementation of the "Local Climate Detectives" project as a pedagogical model of glocalization that integrates global knowledge with the local experiences and actions of students through science activities in primary schools.

## Method

This research uses a qualitative approach with a Literature Review or Conceptual- Theoretical Study. This type of research aims to analyze and synthesize the concept of "Local Climate Detectives" with the Glocalization theoretical framework in the context of IPAS primary school education (AR et al., 2025). The data collected is secondary and divided into three main categories to support the analysis of the project's glocalization, including: Conceptual Project Data consists of information about the core ideas, IPAS learning objectives, forms of implementation, and global achievements of the "Local Climate Detectives" project (Angraini et al., 2025). Glocalization Theory Data consists of fundamental works discussing the theory of glocalization, particularly Roland Robertson's interpenetration model, and comparative theories such as Roudometof (Roudometof & Dessi, 2022).

Education and Climate Context Data consists of: Global Context, where climate change issues are in line with SDG 13, universal scientific concepts, and the role of global organizations such as NASA and UNEP (Tea et al., 2026). Local/Pedagogical Context, where education functions as the transmission of values and culture, as the implementation of IPAS learning, and the environmental phenomena studied by students (Medina et al., 2024).

The selection criteria for references were carried out selectively and purposefully to ensure conceptual relevance and scientific validity: The literature reviewed comes from fundamental books, chapters in books, or reputable scientific journals (Scopus Q1-Q4 or Sinta) that explicitly discuss the theory of Glocalization. Sinta 2-4

journal articles or peer-reviewed or official institutional publications (UNESCO, Ministry of Education) that discuss Science Literacy, Climate Literacy, or Global Citizenship Education, IPAS learning models or science based on local context and scientific inquiry (Mitrolija et al., 2025). Publications are preferred within the last 10-15 years (2010–2025) for climate and IPAS issues, but fundamental works of social theory such as Robertson (1995) are still used. Data analysis was conducted through Qualitative Content Analysis, followed by Comparative-Synthesis Analysis (Rahmat et al., 2025).

## Result and Discussion

Based on the data collection that has been carried out by researchers, the results obtained are that Curriculum Decolonization and the Global-Local Dichotomy. A systematic review of the literature shows that modern education, including science and climate education, is often trapped in a detrimental dichotomy between global (universal) and local (particular) knowledge (Seddon, 2022). Global knowledge about climate change, although important, is often presented in an abstract manner, disconnected from the everyday realities of learners. In response to this crisis of epistemic injustice, in which the local wisdom and experiences of learners are ignored, this study reconstructs the abstract framework of Global Climate Change Education into an action-oriented contextual model: "Local Climate Detectives." This transformation is rooted in the theory of Glocalization (Robertson, 1995) and aims to align universal scientific knowledge with the specific culture and environmental issues of East Java. From Global Abstraction to Glocal Interpenetration (Robertson, 1995). The initial framework of "Global Climate Change" represents the universal dimension of glocalization. The focus is on universally applicable scientific data and principles: the greenhouse effect, global warming, and global mitigation targets (e.g. SDG 13). However, presenting this framework without a local filter causes Cognitive Alienation, where learners perceive climate issues as "someone else's problem" or too big to tackle, causing climate anxiety. Inactivity: Lack of connection to the local context means that learners do not have the agency to action (Seddon, 2022).

The Local Climate Detectives model changes this paradigm through the principle of Interpenetration (Robertson, 1995), which is the process whereby the universal is made specific, and the specific is universalized. Universal (Global Science) becomes Specific (Local): Climate science principles are adapted to explain phenomena experienced by students in their environment (e.g., seasonal flooding, local air pollution). Specific (Local Action) becomes Universal (Global Awareness): The actions and solutions developed by

students in East Java are linked back to global contributions, fostering a sense of Global Citizenship that takes Local Action.

Analytical Description of Conceptual Data for the "Local Climate Detectives" Project. Analysis of the Project's Conceptual Data shows that "Local Climate Detectives" is a pedagogical intervention model designed to address the gap between academic knowledge and environmental reality. Core Ideas and Learning Objectives. The core idea is for students to act as local climate detectives, conducting scientific observations of environmental phenomena in their surroundings, such as temperature, rainfall, and plastic waste, then comparing local data with global information from the BMKG, NASA, and UNEP. The learning objectives of IPAS are dual: to foster scientific and climate literacy and to train scientific inquiry and data analysis skills. Second, to connect global knowledge about climate with students' local experiences, culminating in community-based ecological action (Pielke Jr, 2005). Contextualization of Ecological Phenomena. Students no longer analyze ozone layer data abstractly, but rather analyze: Local Data vs. Global Data in Ecological Systems. Students measure local ecological parameters such as river water quality, soil acidity in agricultural land, and sedimentation levels in reservoirs in their environment. This data is then compared with global data or scientific standards, such as international water quality standards or official rainfall data from the Meteorology, Climatology, and Geophysics Agency (BMKG) to assess the health of local ecosystems (Salvia et al., 2021). Local Ecological Issues and Practices: The investigation focused on environmental issues that are directly experienced and rooted in the local ecosystem, such as the impact of covering rice fields into housing, river pollution caused by local industrial waste, and changes in planning patterns that affect food security (Riaz & Shaukat, 2024). Students learn about agro-ecosystem practices, such as the irrigation system typical of East Java rice fields and drought-resistant endemic plant species as assets for climate mitigation (Demuzere et al., 2022).

Contextualization of Community Values (Culturally Responsive Pedagogy). This model adopts the distinctive values of East Javanese society as the basis for reasoning and action related to ecological functions: The Principle of Rembugan (Deliberation) and Community Openness in Science: Students are encouraged to be bold in raising issues (problem posing) and engaging in open discussions (rembugan) with the community about the ecological injustices they observe (for example, who is responsible for river pollution, or why access to resources is blocked). This openness allows for critical and data-driven analysis of environmental issues within the framework of mutually

agreed solutions (Lestari, 2023). The Principles of Resilience and Local Adaptation in Environmental Action: The resilience of East Java communities in facing environmental change is transformed into Resilient Agro-Ecosystem Reasoning. Students use tactical logic and local ecological assets (e.g., planting endemic tree species, creating simple bio pores) to find quick and appropriate conservation solutions, rather than waiting

for expensive global technological solutions, thereby ensuring the resilience and sustainability of ecosystems in the context of East Java (Kirchhoff et al., 2015).

From the above explanation, the value transformation matrix in the Local Climate Detectives model can be described, illustrating the shift in perspective as shown in Table 1.

**Table 1.** The Value Transformation Matrix in the Local Climate Detectives Model

Global Climate Change	Indigenous Local Ecology	New Glocal Perspective
Universal Scientific Logic Focus on macro climate modelling, global carbon data, and Greenhouse effects.	Local Functional Ecology Water resource management practices, e.g. irrigation systems in East Java rice fields, endemic plant species that are adaptive to the seasons.	Resilient Agro-Ecosystem Reasoning Using global scientific principles (e.g. hydrology, physics) to solve local ecological problems (e.g. drought, land degradation) by optimising local ecological assets.
Environmental Stewardship Global Responsibility. Universal values regarding conservation and sustainability that are often policy-based or declarative in nature.	Principles of Prosperous Farming, Sustainable Earth Environmental ethics that view humans as part of nature. Collective values in preserving vital resources e.g. protected forests, springs.	Communal Ecological Equity Using science to ensure the sustainability of ecosystem functions e.g. water quality, water absorption for the common good, rather than individual profit or land exploitation.
Inclusive & Structured Learning based on formal science curricula and global modules on mitigation.	Field Science Action. Ecosystem Investigation. Exploration-based learning in rice fields, rivers, or urban forests. Involves observing biodiversity and human-nature interactions.	Dialectic Ecosystem Inquiry Classrooms become open laboratories where students dare to criticise ecological issues e.g. river pollution, land conversion and formulate solutions based on local environmental data.
Global Citizenship Awareness of the impact of global emissions and the role of citizens of the world.	People of Surabaya (Conservationist) Identity A sense of pride and ownership of the local ecosystem e.g. Surabaya Mangrove Forest, Mount Bromo.	The Brave Climate Steward (Glocal Conservationist) Students who understand global threats but have the agency and courage to become pioneers in the conservation and restoration of ecosystems unique to East Java.

Table 1 explains that Contextualization of Ecological Phenomena focuses on scientific investigation of local natural systems. Students no longer analyze abstract concepts such as ozone layer data, but are directly involved in Field Science Action by measuring local ecological parameters (Yang et al., 2021). For example, they measure river water quality or the acidity level of agricultural soil, then compare this data with global scientific standards to assess the health of the local ecosystem (Hernández-Blanco et al., 2022). This investigation focuses on issues rooted in the regional ecosystem, such as the impact of rice field conversion or changes in planning patterns that affect food security. Students are encouraged to study agro-ecosystem practices unique to East Java, such as irrigation systems or drought-resistant endemic plant species, as local assets in climate mitigation (Haque, 2023). Second, Contextualization of Community Values utilizes social principles unique to East Java to build environmental reasoning and action. These values are embodied through the principles of Rembugan (deliberation) and

Community Openness in Science. Students are encouraged to dare to raise issues (problem posing) and engage in open discussions (rembugan) with the community about the ecological injustices they observe, ensuring that the solutions formulated are based on local environmental data and agreed upon by all. In addition, the principles of resilience and local adaptation from the people of East Java are transformed into Resilient Agro-Ecosystem Reasoning. Students use tactical logic to implement conservation solutions that utilize local ecological assets, such as planning endemic tree species or creating simple bio pores, thereby ensuring the sustainability of ecosystem fun cons without relying on global technological solutions that may not be relevant or affordable (Singh, 2018).

The Local Climate Detective Learning Model into Learning Syntax. The structure of the "Local Climate Detectives" implementation guides students through the process of qualitative content analysis of their environment, which produces glocal achievements at each stage.

The "Local Climate Detectives" project is a structured learning model designed to integrate the local environmental context with global climate issues through five main stages. The first stage is local observation, in which students take empirical measurements such as temperature, rainfall, and environmental conditions, with the aim of obtaining a local context in the form of the students' real experiences (Bascope et al., 2021). Next, in the data analysis stage, students compare the data they have collected locally with global climate data from sources such as NASA and BMKG, so that students achieve a global perspective or understanding of the interconnectedness of phenomena (Batool & Haleem, 2022). The results of this analysis are

then translated into local action, namely creating mini campaigns or school greening projects, which are local implementations of the global SDG 13 goal. The culminating stage is global citizenship reflection, where students conclude how small actions taken in their local environment impact the world, resulting in an awareness of glocalisation (Riaz & Shaukat, 2024). These five stages collectively create an inquiry process that integrates global scientific knowledge with community-based ecological responsibility (Roudometof & Dessì, 2022).

This model operationalises the Glocalization and Science Action framework into systematic pedagogical steps, with a focus on the ecology of East Java.

**Table 2.** The Syntax Stages of the Local Climate Detective Learning Model

Syntax Stage	Key Activities	Glocalisation Objectives	Learner Character Outcomes
Global Orientation (O- G)	Universal Climate Issues and Basic Scientific Concepts	Global Epistemology and Climate Literacy	Scientific Outlook and Universal Concepts
Ecological Observation (O-E)	Measurement of Local Ecosystem Parameters and Recording of Local Phenomena	Local. Phenomena and Students' Real Experiences	Environmentally Aware and Observant
Correlation Reasoning (N-K)	Dialectic Ecosystem Inquiry. Analysis of Local Data vs. Global Data	Epistemology and Glocalization. Resilient Ecological Reasoning.	Critical, Analytical, and Solution Oriented
Community Action (CA)	Formulation of Solutions & Implementation of Local Conservation Projects e.g. Biopores, Reforestation	Cultural and Pedagogical. Communal Ecological Equity and Field Action	Collaborative and Responsible
Glocal Reflection (R- G)	Impact Assessment of Actions and Awareness of Global Contributions	Glocal Identity. The Brave Climate Steward and Global Citizenship.	Courageous and Ecological Character

From Table 2. Regarding the syntax stages of the Local Climate Detective learning model, it can be explained that: Global Orientation (OG). Focuses on building the foundation of climate literacy. The activity involves the teacher introducing global-scale scientific phenomena (e.g., the greenhouse effect, carbon pollution) and the importance of global targets (SDG 13). The role of glocalization demonstrates that the issues to be investigated have universal context and relevance. Ecological Observation (EO). Focuses on anchoring learning in Local Functional Ecology. The activity involves students conducting field science activities by measuring parameters of the nearest ecosystem, such as temperature, water quality, vegetation, and river conditions. Its role in globalization is to transform learning from abstract concepts into real-life experiences for children. Correlation Reasoning (CR). Focuses on epistemic synthesis and robust ecological reasoning. The activity involves students analyzing local observation data (OE) and comparing it with global climate data (NASA) or regional data (BMKG). This is Dialectical Ecosystem Investigation using global formulas, such as hydrology and physics, to solve local ecological

problems. The role of glocalisa on is mutual shaping, whereby local observations are enriched by global scientific understanding (Robertson, 1995). Community Action (CA). The focus is on cultural strengthening and community ecological justice. The activity involves students formulating solutions and implementing local implementations aligned with the principles of prosperous farming, sustainable earth East Java Ecology (Abida et al., 2023). This could take the form of small ecosystem restoration projects, such as biopore construction or a campaign to manage plastic waste in local rivers. Role of Glocalization: Translating global sustainability values into contextual practices, ensuring ecosystem functions are maintained for collective well-being. Glocal Reflection (RG). The focus is on the formation of glocal identity. The activity involves students concluding how their conservation actions in East Java Ecology contribute to the global movement. They reflect on their role as Glocal Conservationists (The Brave Climate Stewards) who are brave (wani) in taking agency amid global threats (Chandler et al., 2025). Role of Glocalization: Strengthening a sense of belonging to

the global community as local learning outcomes enrich global awareness.

### *Discussion*

Structure of Glocal Implementation and Achievements. The implementation structure of "Local Climate Detectives" guides students through the process of qualitative content analysis of their environment, which produces Glocal Achievements at each stage. Robertson's Theory of Harmony: Interpenetration and Mutual Shaping (Robertson 1995) defines Glocalization as a process of interpenetration and hybridization between global values and local contexts, in which the universal and the particular mutually shape each other. The synthesis of the "Local Climate Detectives" project fully reflects Robertson's ideas. Interpenetration occurs when students use global climate concepts (universal) but relate them to local realities, floods temperature (Chen et al., 2023). The data collected locally by students is given meaning and a framework for interpretation through global data, resulting in mutual shaping of knowledge: global knowledge becomes meaningful because it is brought to life locally. Pedagogical Implications of the Data Analysis Process Comparing local data with NASA data in "Local Climate Detectives" is an arena where "the simultaneity of the universal and the particular" is pedagogically activated, transforming abstract global issues into pressing local problems (Vourlidis et al., 2023). Critical Comparison with Comparative Theory Although other theories have points of contact, Robertson provides the strongest analytical framework: Local Adaptation "Local Climate Detectives" demonstrates the adaptation of global methods to the SD context using simple tools from recycling, similar to Roudometof's idea of Counter to McDonaldization. However, Robertson more effectively captures the cognitive integration between knowledge itself (Roudometof & Dessì, 2022). Transnational Connectivity "Local Climate Detectives" involves the use of global information networks. However, Roudometof focuses on cross-border connectivity, while "Local Climate Detectives" focuses on curricular integration within schools, with the potential for external collaboration (V. Roudometof, 2016).

The Urgency of Education Glocalization for IPAS Learning. The urgency of education glocalization, particularly in the context of Science and Social Studies (IPAS) learning at the primary school level, is very high because it faces major issues related to preparing students to participate in the global world without losing their identity and local wisdom (Ramlan et al., 2023). The following are the urgent points of education glocalization for IPAS learning, supported by the contextual data you have provided: Overcoming the Dichotomy of Knowledge and Epistemic Justice.

Glocalization is urgently needed to address the harmful dichotomy between global and local knowledge: The Challenges of Globalization: Education systems are forced to meet global standards, while local knowledge, such as environmental wisdom and agro- ecosystem practices in East Java, is slowly being marginalized. Preventing Epistemicide, A process of systematic marginalization that eliminates the knowledge, language and world perspectives of learners in their daily lives. Indigenous local knowledge is often considered irrelevant to the future. Glocalization (such as the Local Climate Detectives model) is a conscious effort to create learning experiences that are truly contextually relevant to learners and prevent epistemicide (the erasure of knowledge). Realizing Epistemic Justice, Learning that only validates the knowledge of dominant groups creates cognitive alienation for learners. Glocalization demands epistemic parity between global knowledge (universal scientific concepts) and local knowledge (local functional ecology). Building Contextual Climate Literacy and Agency. In IPAS (Climate Science) learning, glocalization is essential to bridge abstract theory with concrete action: Relevance of Learning: Global climate issues (Global Climate Change) are often abstract (e.g., carbon data, ice rise). Glocalization, through the Local Climate Detectives model, links global scientific concepts to real phenomena around children (e.g., local flooding, river conditions, changes in weather patterns in the area), making them meaningful (Faradita, 2021).

Application of Scientific Concepts: Students use global scientific concepts (e.g., the greenhouse effect) to analyze local phenomena (e.g., why their area is getting hotter). This trains scientific thinking and data analysis skills (scientific inquiry & data literacy). Encouraging Action and Agency: Glocalization is not only about understanding, but also action. Glocal models (such as Local Climate Detectives) aim to build community-based ecological awareness and action. Students carry out local implementations (e.g., greening projects, waste sorting) as manifestations of global goals (SDG 13). Developing Resilient Reasoning. Glocalization in IPAS fosters more adaptive thinking skills: Interpenetration (Robertson): Glocalization is a process of interpenetration and hybridization between global values and local contexts. Learning becomes an arena where global scientific knowledge is interpreted locally. Resilient Ecological Reasoning: In the context of East Java Ecology, glocalization produces Resilient Ecological Reasoning/ Resilient Agro-Ecosystem Reasoning (Cao et al., 2025). Students learn to use tactical logic and local ecological assets (such as irrigation systems) to find effective conservation solutions, rather than relying on unrealistic global ideal solutions (Chang et al., 2023).

Educational Context and Climate (Implementation of Glocalization). Contextual data analysis supports that the implementation of "Local Climate Detectives" is an effective strategy for addressing curriculum challenges and achieving educational goals: Integration of Global Context (SDG 13) and Local Context (Value Inheritance). The alignment of SDG 13 with "Local Climate Detectives" directly implements SDG 13's goal of "Take urgent action to combat climate change" through the Local Action stage. Global values such as sustainability are translated into local practices such as planting trees and sorting waste (Gunansyah et al., 2021). The transmission of values in this project supports the function of education as a transmitter of values and culture by linking local traditions (e.g., mutual cooperation) as a form of adaptation to climate change. This ensures that climate awareness is not only scientific but also rooted in local ethics (Rieckmann, 2017). The Contribution of "Local Climate Detectives" to Literacy and the Rejection of Hegemony. Scientific and Data Literacy: By training students in empirical observation and data comparison, "Local Climate Detectives" fosters data literacy and scientific inquiry, which are important components of modern Science Literacy (Haque, 2023). Overcoming Knowledge Hegemony: "Local Climate Detectives" effectively bridges the gap between theory and practice, challenging the hegemony of uniform scientific knowledge often found in curricula. Students use global data (NASA) to validate their own local findings, empowering them as participants in knowledge production, not just consumers (Paschal, 2022). This fosters an awareness of glocalization and a responsible global citizen identity.

From the results of the research and discussion above, the findings are in line with the theory of glocalization in analyzing how transnational (global) policies and issues are interpreted, adapted and responded to in the context of local culture and education. The focus is on the dialectical process between globalization and localization, especially in shaping Global Citizenship Education. The results show that the meaning of Global Citizenship is not uniform, but is always renegotiated and brought to life through particular social and cultural practices. This is similar to the "Local Climate Detectives" project, which encourages students to feel like "World Citizens" through local action (Lestari, 2023).

In line with research from Pertiwi1b et al. (2019) highlights the urgency of climate change-based education to support Sustainable Development Goals (SDGs), similar to the focus of "Local Climate Detectives" on SDG 13. This study often adopts a problem-based learning model related to climate and environmental issues. The findings show a significant increase in the ability to identify and master climate-related

knowledge, as well as the development of students' competencies and confidence to initiate local adaptation and mitigation practices. The emphasis on real action and the development of scientific competencies is highly relevant to the objectives of "Local Climate Detectives".

The Local Climate Detective Model in Learning Syntax: Theoretical Perspective & Latest Research Support. The Local Climate Detectives learning model represents an effective and relevant framework for educational glocalization, radically addressing the dichotomy between global knowledge and the local experiences of students in East Java. This model is supported by the Glocal Ecological Action Syntax (OONAR), which is designed to transform students from passive recipients of information into empowered citizen scientists. Theoretically, this syntax is based on the principle of mutual shaping (Robertson, 1995), which asserts that universal knowledge (climate science) becomes meaningful only when translated and lived through the particular ecological context of East Java.

The initial stages of syntax, Global Orientation (GO) and Ecological Observation (EO), serve as a critical approach to a centralized curriculum. GO ensures that students have global climate literacy, understand scientific concepts and universal targets such as SDG 13 (Rieckmann, 2017). Immediately after that, the EO stage applies the principles of Culturally Responsive Teaching (CRT) and Decolonizing Methodologies (Shields et al., 2024) by anchoring learning to the ecology of East Java. Students conducted field science activities by measuring ecological parameters such as river water quality or local agricultural land conditions and using this empirical data as a starting point for investigation (Bieroza et al., 2023). This action is crucial to prevent epistemicide and cognitive alienation, where students' knowledge and reality are recognized as valid scientific data.

The core of glocalization lies in the Correlation Reasoning (CR) stage. At this stage, the model implements Inquiry-Based Learning (IBL) in a dialectical manner, whereby local ecological observation data is analyzed and validated against global standards or data e.g., BMKG or NASA (Mulyani et al., 2025). This process achieves Epistemic Justice because learners do not merely receive formulas, but use global scientific principles (e.g., hydrology, physics) to critique and solve local ecological problems (Das, 2025). The cognitive outcome is Resilient Agro-Ecosystem Reasoning, which is the ability to solve complex environmental problems by optimizing local ecological assets (e.g., irrigation systems, endemic plants) rather than relying on unrealistic technological solutions (Stringer et al., 2024).

The last two stages, Community Action (CA) and Glocal Reflection (GR), transform learning into real action. CA is based on Participatory Action Research (PAR), in which conservation solutions (e.g., bio pore

creation, land restoration) are formulated through deliberation (rembugan) and aim for Community Ecological Justice. This model ensures that environmental actions are not only individual but collective, in line with the values of East Javanese society. Finally, RG strengthens the Glocal Identity of students. Recent research highlights the importance of identity-respecting curricula in building agency and a sense of belonging (Penrod & Kaly, 2024). By reflecting that their small actions in the East Java Ecosystem are direct contributions to global goals, students are convinced that they are Glocal Conservationists who have the courage to be agents of change amid global climate threats.

## Conclusion

This model fundamentally addresses the dichotomy between universal knowledge, such as the concept of the greenhouse effect and SDG 13 targets, and particular realities, such as the phenomenon of flooding or land use change in East Java Ecology. Through a Culturally Responsive Pedagogy approach, this project positions students as climate detectives, transforming them from passive recipients of information into active subjects in scientific inquiry into their surrounding environment. The core of this model's success lies in the realisation of Roland Robertson's Theory of Glocalization, namely the process of Interpenetration or Mutual Shaping between the global and the local. This is operationalized through the OONAR syntax (Global Orientation, Ecological Observation, Correlation Reasoning, Community Action, Glocal Reflection). The key stage of Correlation Reasoning (NK), where students compare local observation data (e.g., river water quality) with global data (NASA/BMKG), becomes the arena for activating Epistemic Justice. This process transforms abstract knowledge into Resilient Agro-Ecosystem Reasoning, enabling students to formulate conservation solutions based on local assets and in line with the values of Community Ecological Justice (such as the principle of Rembugan). The implementation of the "Local Climate Detectives" model demonstrates the high pedagogical urgency of building contextual Climate Literacy and Agency. This project not only improves scientific and data analysis skills, but also fosters the Glocal Identity of students, symbolized as "The Brave Climate Steward". Students ultimately understand that small conservation actions in the East Java Ecosystem are direct contributions to global goals, affirming the function of education as a transmitter of values and culture as well as a bold agent of change in facing global climate challenges.

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## Conflicts of Interest

The authors declare no conflict of interest.

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