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TRANSFORMING PROFESSIONAL DEVELOPMENT THROUGH THE EMMA MENTORSHIP FRAMEWORK TO STRENGTHEN CLIMATE CHANGE EDUCATION IN UNDER-RESOURCED CONTEXTS

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Abstract **-** Global education systems are grappling with the intertwined challenges of climate crises and persistent teacher capacity deficits. In many under-resourced contexts, particularly in Sub-Saharan Africa, conventional models of continuous professional development (CPD) for teachers are sporadic, inadequately contextualized, or structurally top-down, thereby failing to meet the practical realities of teachers' daily work. This paper proposes EMMA mentorship framework as a compelling alternative and complementary model for teacher professional learning, particularly in climate change education (CCE). Unlike traditional CPD approaches, mentorship is peer-driven, contextually grounded, and rooted in collaborative growth. Drawing insights from recent empirical studies on Nigerian teachers' climate science literacy, content awareness, and expressed training needs, this paper argues for a paradigmatic shift from episodic workshops to sustained, community-embedded mentorship. Such mentorship frameworks promote experiential learning, co-construction of knowledge, localized pedagogical innovation, and culturally responsive teaching. Furthermore, mentorship cultivates leadership, reciprocity, and transformative agency, offering a scalable pathway to embedding Education for Sustainable Development (ESD) in teacher education systems. By centering local voices and lived realities, the paper contributes to contextualizing professional development and advancing educational equity amid escalating climate threats.

Keywords: Climate education; professional development; peer learning; teacher education; transformative mentorship

The CPD Crisis in a Warming World

Education systems are saddled with preparing future generations for prevalent and future environmental challenges through climate change education (CCE) (Schreiner et al., 2005). The Intergovernmental Panel on Climate Change (IPCC, 2023) documents the impacts of the climate crisis in many regions of the world, including disrupted ecosystems, livelihoods, and social fabrics, especially in more vulnerable countries of the Global South. Yet, as observed by Ennes et al (2021), teachers as the frontline implementers of the ambitious educational agenda with CCE are often underprepared, unsupported, and systemically constrained. Moreover, despite widespread recognition that teacher quality is one of the most influential in-school factors shaping student learning (Engida et al., 2024), professional development models that could strengthen teacher agency and expertise remain largely inadequate in both form and function.

In Sub-Saharan Africa, the shortcomings of conventional continuous professional development (CPD) for teachers are particularly glaring. Traditional CPD programs are typically characterized by sporadic workshops, centrally administered content, and a top-down transmission model that seldom accounts for teachers' contextual realities or pedagogical autonomy (Chalchisa, 2011; Abakah, 2019; Adagiri, 2014). These interventions often result in little more than a checklist of training activities, failing to

produce sustained improvements in teacher practice, confidence, or content mastery. In Nigeria, for instance, both in-service and pre-service teachers exhibit significant gaps in climate literacy, pedagogical strategies, and utilization of learner-centered techniques (Eze & Nwagu, 2021; Onwuzurike & Eze, 2022; Eze et al., 2022). Even where awareness of climate change concepts exists, application remains shallow, with many teachers reverting to rote, examination-oriented delivery modes (Teixeira & Crawford, 2022). This reality is especially troubling in light of the transformative goals of CCE delivered through what Leite (2024) refers to as *'sustainability pedagogies that help learners build capacity for understanding and acting on climate change'*, which call for holistic engagement across cognitive, affective, and action domains (Monroe et al., 2017). Therefore, this paper argues that the current CPD architecture must undergo a paradigmatic shift, moving from event-based, externally driven training sessions to sustained, peer-supported, and contextually grounded models of professional learning.

Mentorship is one of such models, which Alsaadi (2025) opines has been overlooked in many formal educational reform efforts, despite its potential to humanize teacher development and foster authentic pedagogical change. In this context, mentorship refers to structured, relational, and reciprocal engagements among teachers, often between 'experienced' and 'novice' educators, geared toward reflective practice, collaborative learning, and local innovation (Orland-Barak & Hasin, 2010). Thus, this paper explores the affordances of mentorship for enhancing localized, culturally relevant, and emotionally resonant CCE practices in under-resourced settings. By doing so, the paper points to the urgent need for an alternative and complementary professional development model that delivers knowledge and cultivates agency, resilience, and purpose among educators working at the frontline of climate vulnerability.

The Inadequacies of Conventional CPD Models

Despite decades of reform rhetoric, the dominant forms of teacher professional development in many education systems, particularly in Sub-Saharan Africa, remain woefully misaligned with the complex demands of climate change education (Mitchell et al., 2024). These conventional models typically take the form of periodic workshops, short-term seminars, and cascade training formats, often designed without the input of the teachers they are meant to support (Soforon et al., 2023; Haßler et al., 2021). Such structures are ill-suited to equipping teachers with the dynamic competencies, contextual judgment, and emotional resilience required to deliver transformative education in the face of climate disruption.

One of the most salient critiques of traditional CPD is its episodic and disconnected nature. Teachers are frequently invited to attend "one-off" training sessions that neither follow a coherent learning trajectory nor include mechanisms for feedback, application, or sustained growth (Abakah, 2023). These models are often externally funded and donor-driven, focusing on compliance over creativity and superficial coverage over depth (O'Sullivan, 2001). When evaluated (e.g., in Revina et al., 2023; Ventista & Brown, 2023), these one-off CPD sessions tend to demonstrate low impact on instructional practice and virtually no long-term improvement in student learning. Contextual evidence from Nigeria illustrates the extent of this disconnect. A multi-zonal needs assessment (Eze & Nwagu, 2021) involving in-service teachers revealed widespread demand for training in learner-centered and participatory strategies specific to CCE, including fieldwork, role-playing, simulations, and value clarification techniques. These studies identify professional gaps that were consistent across gender, teaching experience, and

geographical location, signaling that they are not isolated anomalies but systemic deficiencies. Similarly, recent investigations into pre-service teacher preparedness revealed limited awareness and application of core CCE methodologies, despite completion of environmental education coursework (Onwuzurike & Eze, 2022). Hence, the absence of practical mentoring, classroom modeling, or sustained pedagogical scaffolding possibly contributes to a persistent theory-practice gap, leading to ineffective CCE.

These limitations are not unique to Nigeria. Across much of Africa and the Global South, CPD remains largely decontextualized from the lived realities of teachers and students (Soforon et al., 2023; Haßler et al., 2021; Abakah, 2023; Mitchell et al., 2024). Beyond pedagogical limitations, the structural design of CPD in many low-income settings fails to account for the professional ecology in which teachers operate (United Nations Educational, Scientific and Cultural Organization (UNESCO), 2023). Classrooms are often overcrowded, resources are scarce, and school management structures may lack the institutional culture to support ongoing learning. In such environments, CPD becomes an administrative formality rather than a meaningful vehicle for transformation. These constraints are exacerbated by policy models that define success in narrow, input-based terms (e.g., number of workshops conducted, materials distributed, or teachers reached) without evaluating long-term teacher development or instructional change. The resulting reality is that teachers, particularly those at the frontline of environmental vulnerability, are underprepared to translate the goals of CCE into contextually meaningful pedagogical practices. Without deliberate shifts toward CPD approaches that recognize teachers as knowledge co-constructors and context experts, the potential of climate education to empower both learners and educators remains unrealized. These limitations point to the need for alternative frameworks that are locally responsive, pedagogically grounded, and professionally sustaining.

Mentorship as a Contextual and Transformative Strategy

In response to the persistent limitations of conventional CPD models, mentorship is gaining recognition as a context-responsive and professionally empowering alternative (Abakah, 2023; Bignell & Holligan, 2023). Its relevance is especially pronounced in under-resourced educational systems, where the need for continuous, collaborative, and culturally grounded professional learning is acute. Unlike one-off workshops, mentorship offers a sustained, relational, and dialogic approach to teacher development, matching the demands of CCE more closely.

Mentorship can play a dual role of CPD for both mentors and mentees (Hudson, 2013). Hence, in the CPD context, mentorship refers to structured, peer-based engagements wherein experienced educators support less-experienced colleagues through a process of co-reflection, modeling, feedback, and contextual adaptation of practice. Clearly, it departs from traditional CPD models, which are more hierarchical or prescriptive, to emphasize mutual learning, trust-building, and the co-construction of knowledge within shared professional realities (Byars-Winston & Dahlberg, 2019). Thus, sustained interpersonal engagement from mentorship allows for teachers' professional learning that is both situated and transformative. As such, mentorship creates a platform for pedagogical experimentation, localized innovation, and affective support, which are useful elements for teachers navigating the complex demands of CCE.

The theoretical grounding for mentorship draws from experiential and transformative learning frameworks. Experiential Learning Theory (Kolb, 1984) posits

that effective learning occurs through cycles of concrete experience, reflective observation, conceptualization, and active experimentation. Such an iterative process can be naturally facilitated within a mentorship relationship. Similarly, Mezirow's (1997) theory of transformative learning highlights the importance of critical reflection and dialogic engagement (Cranton, 2006) in enabling educators to question assumptions, shift mindsets, and integrate new practices. Within a mentorship model, these learning processes are embedded in professional relationships, rather than imposed through abstract content delivery. Mentorship is also highly adaptable to the contextual realities of Sub-Saharan African education systems. In many schools, informal peer support already functions as an unofficial source of guidance and morale-building (Mitchell et al., 2024). When formalized and strategically supported, these interactions can evolve into cost-effective mechanisms for pedagogical renewal and capacity building. Unlike externally driven CPD programs, mentorship leverages existing human capital, institutional knowledge, and community insights, which make the approach both scalable and culturally sustainable.

Furthermore, research on mentorship in education demonstrates its efficacy across multiple dimensions of teacher development (see Bhardwaj et al, 2025; Zhang et al., 2024; Rockoff, 2008; Callahan, 2016). Studies have shown that mentored teachers are more likely to adopt innovative pedagogies, demonstrate professional resilience, and maintain higher levels of morale and commitment. In the context of CCE, mentorship can support educators in adapting climate content to local socio-ecological contexts, utilizing participatory methods, and navigating sensitive issues with cultural sensitivity. This is particularly critical in resource-constrained environments where formal training opportunities are infrequent and classroom realities are unpredictable (Eze et al., 2022). Consequently, fostering long-term professional relationships through mentorship addresses pedagogical gaps, emotional and professional isolation, creating a holistic scope often underacknowledged in CPD design. It ultimately enhances teacher agency, reinforces professional identity, and cultivates a sense of belonging within a shared educational mission. These relational dynamics are essential for embedding climate action within education systems and for nurturing teachers as change agents rather than passive implementers of external curricula. Overall, mentorship is both an alternative to traditional CPD and a paradigm shift in how professional learning is conceptualized and delivered.

Operationalizing the EMMA Mentorship Framework for Teacher CPD

To translate the potential of mentorship into scalable and context-sensitive practice, a structured framework is required, which responds to the pedagogical, relational, and institutional dimensions of teacher professional development. The EMMA framework comprises four interlinked pillars: Empower, Match, Model, and Anchor. It is proposed as a strategic approach to embedding mentorship within CPD systems, particularly for CCE in under-resourced settings. Figure 1 visualizes the EMMA framework, operationalizing its four pillars for teacher mentorship.

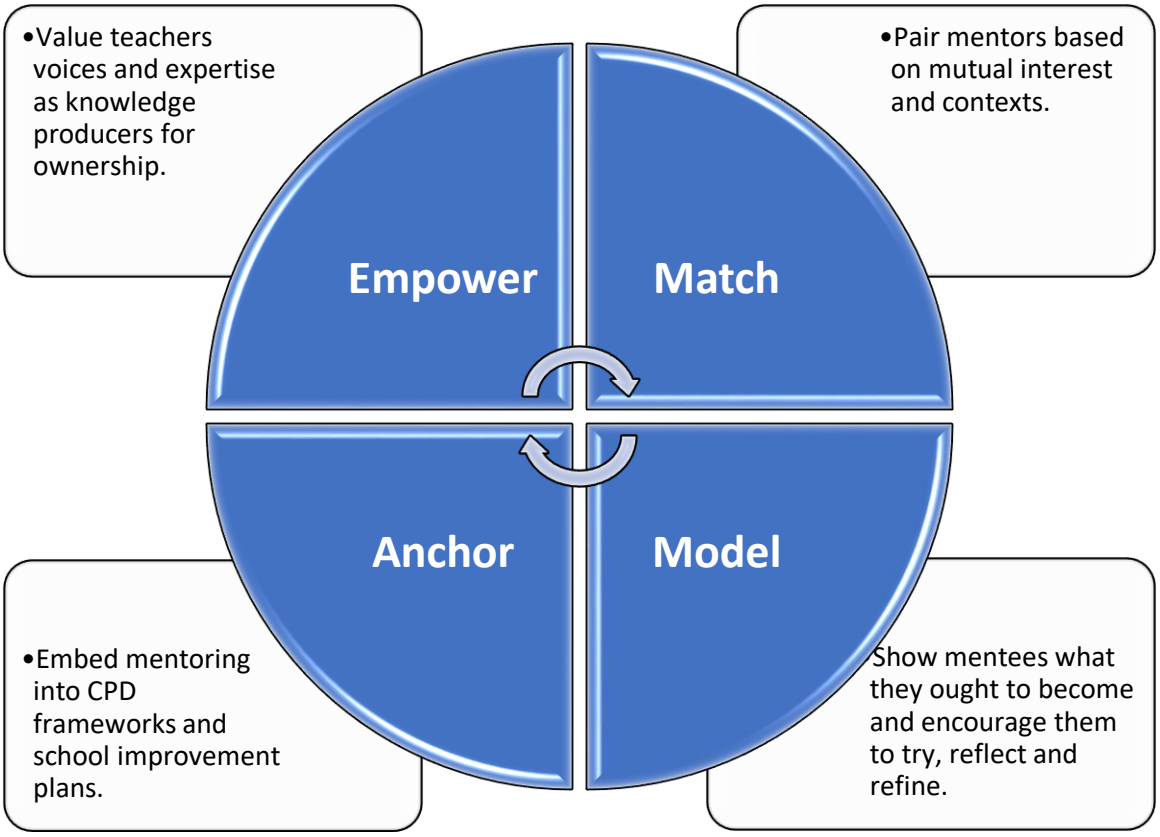

Figure 1: EMMA (Empower, Match, Model, Anchor) teacher mentorship framework for CPD in CCE

Empower: *Valuing Teachers as Knowledge Producers and Agents of Change*

The first pillar, *Empower*, repositions teachers not as passive recipients of externally designed knowledge but as co-creators of pedagogy and local educational leadership. Effective mentorship begins by validating the professional expertise, lived experiences, and contextual knowledge that teachers bring to their practice. In the context of CCE, empowerment entails enabling teachers to design, adapt, and lead instructional strategies that reflect both scientific content and local realities. Empowered mentors are better equipped to nurture innovation, facilitate reflective practice, and support professional confidence among their mentees.

Match: *Mentor-Mentee Pairing Based on Context and Mutual Interest*

The **Match** dimension emphasizes intentional mentor-mentee pairing based on shared subject interests, school type, cultural context, and professional or pedagogical goals. A mismatch in these areas often leads to disengagement, surface-level interactions, or misaligned expectations. Drawing from the concept of "cognitive congruence," this pillar ensures that mentorship relationships are built on trust, mutual respect, and shared professional language. (Fladerer et al., 2023; Orland-Barak & Hasin, 2010). In resource-constrained systems, where school clustering and teacher redeployments are common, intentional matching provides stability and relevance to mentorship engagements.

Model: *Guiding Mentees by Example and Encouraging Reflective Practice*

Modeling underscores the pedagogical dimension of mentorship. Mentors are not only advisors but also exemplars, who offer mentees opportunities to observe, replicate,

and refine best practices in authentic classroom settings. This includes demonstrations of locally adapted CCE strategies such as place-based inquiry, simulation activities, and the use of culturally resonant examples to engage learners. Also, modeling fosters critical reflection, as mentees are encouraged to evaluate, question, and adapt observed practices to fit their contexts (Revina et al., 2023; Soforon et al., 2023). When embedded in a continuous feedback loop, modeling enhances instructional quality and deepens pedagogical insight.

Anchor: *Embedding Mentorship within Systems and Structures*

The final pillar, *Anchor*, addresses the often-overlooked need for systemic integration. Without institutional commitment, mentorship risks remaining informal, short-lived, or peripheral to mainstream CPD (O'Sullivan, 2001; Rockoff, 2008). Anchoring requires educational authorities and training institutions to embed mentorship structures within school improvement plans, teacher induction processes, and appraisal systems. This includes allocating time for mentorship activities, developing assessment tools for mentoring effectiveness, and formally recognizing mentors' contributions in career progression frameworks. Anchoring ensures sustainability and scalability, making mentorship an integral part of teacher development ecosystems. Through anchoring, mentorship can lead to a sustainable change in African teacher development, which Mitchell et al. (2024) describe as the move from the project to the programmatic level.

Localizing Mentorship and Addressing Feasibility

The success of any professional development model lies in the conceptual merit, cultural institutional, and material adaptability, within which it is deployed. In Sub-Saharan Africa, where education systems often function within constraints of limited infrastructure and systemic inequities, localized approaches are essential for meaningful and sustainable reform. The EMMA mentorship framework, by design, responds to these conditions. Unlike standardized, externally driven CPD models, mentorship is inherently flexible. It enables teachers to draw on indigenous knowledge systems, respond to community-relevant climate issues, and adapt pedagogical strategies to fit local contexts. This flexibility enhances the relevance and impact of CCE by grounding it in learners' lived experiences.

Moreover, the EMMA mentorship framework leverages pre-existing school dynamics. For example, informal collaboration, peer support, and shared professional values, can be transformed into structured, cost-effective, and culturally grounded systems of professional learning. Also, through reciprocal dialogue, shared observation, and co-reflection, teachers co-create knowledge and strengthen collective efficacy, thereby fostering professional solidarity. Ultimately, the EMMA mentorship framework is designed with equity and reflexivity in mind and requires rooting in local realities to achieve a scalable, context-sensitive, and socially just pathway for advancing teachers' professional development in CCE. However, implementing mentorship at scale is not without challenges. A key risk lies in the uncritical reproduction of hierarchical power structures, where mentoring becomes directive rather than dialogic. Without training that emphasizes co-learning and mutual respect, mentorship could reinforce rather than disrupt systemic inequalities (Goerisch, 2019). Additionally, resource limitations may pose barriers to sustainability. Yet evidence from initiatives like Fundisa for Change (Schudel et al., 2021) demonstrates that relational, school-embedded models can yield meaningful pedagogical transformation, even with minimal financial investment.

Conclusion

The intensifying climate crisis requires more than curriculum reform or technical upskilling for addressing the pedagogical demands of CCE. A fundamental shift in how teacher professional development is conceptualized and delivered is needed now more than ever. The prevailing CPD architecture, characterized by episodic workshops, external content delivery, and minimal contextual engagement, has proven inadequate in preparing teachers to navigate the interdisciplinary, values-laden, and action-oriented dimensions of CCE, particularly in under-resourced contexts. This paper has argued for mentorship as a viable and transformative alternative to conventional CPD. Anchored in sustained professional relationships, contextual relevance, and co-constructed learning, mentorship responds to the instructional, emotional, and cultural needs of educators working on the frontlines of climate vulnerability.

The EMMA framework, comprising Empower, Match, Model, and Anchor as pillars, offers a structured yet adaptable model to operationalize mentorship within diverse educational ecosystems. Leveraging existing professional networks and institutional knowledge, the EMMA framework enables the development of resilient, community-embedded approaches to teacher learning. By fostering reflexivity, critical thinking, and collaborative practice the framework proposed in the study creates situative conditions for teachers to lead climate-responsive pedagogical innovation. Institutional commitment is required for embedding mentorship into national, regional and state CPD strategies, teacher education curricula, and school improvement policies. Further steps are required for developing guidelines for mentor selection, allocating time and resources for mentorship activities, and formally recognizing the contributions of mentors within career progression frameworks. Without such systemic groundwork, the promise of mentorship risks remaining peripheral to mainstream professional development discourse. Given that teachers require solidarity, support, and space to grow, a mentorship-centered paradigm offers a significant shift for education systems in under-resourced contexts. Finally, the EMMA mentorship framework warrants rigorous empirical validation through experimental and quasi-experimental studies, particularly within low-income educational settings. Future research should evaluate outcomes such as teacher knowledge gains, shifts in pedagogical beliefs, classroom practice, student engagement, and long-term sustainability. Bold reforms are now imperative, and teacher education institutions must transcend "business as usual" and embrace professional development models that empower teachers to lead meaningful educational change.

REFERENCES

Abakah, E. (2019). *Continuing professional development (CPD) of teachers in Ghana: An exploration of basic school teachers' practices and experiences* (Doctoral dissertation, University of Technology Sydney (Australia)).

Abakah, E. (2023). Teacher learning from continuing professional development (CPD) participation: A sociocultural perspective. *International Journal of Educational Research Open*, *4*, 100242. https://doi.org/10.1016/j.ijedro.2023.100242

Adagiri, S. O. (2014). *A comparative study of teachers' continuing professional development (cpd) in Nigeria and England: A study of primary schools in Abuja and Portsmouth* (Doctoral dissertation, University of Portsmouth).

Alsaadi, A. (2025). Enhancing Educational Quality: Reforming Mentorship Practices in Private Higher Education. *Proceedings of the 6th African International Conference on Industrial Engineering and Operations Management Rabat, Morocco, April 7-10, 2025*. https://ieomsociety.org/proceedings/morocco2025/31.pdf

Bhardwaj, V., Zhang, S., Tan, Y. Q., & Pandey, V. (2025). Redefining learning: student-centered strategies for academic and personal growth. In *Frontiers in Education*, 10, 1518602. https://doi.org/10.3389/feduc.2025.1518602

Bignell, C., & Holligan, C. (2023). It's good to talk: professional development through dialogic co-coaching in the primary school classroom in England. Education 3-13, 53(4), 503–517. https://doi.org/10.1080/03004279.2023.2206412

Byars-Winston, A., & Dahlberg, M. L. (2019). *The Science of Effective Mentorship in STEMM. Consensus Study Report*. National Academies Press. 500 Fifth Street NW, Washington, DC 20001.

Callahan, J. (2016). Encouraging retention of new teachers through mentoring strategies. *Delta Kappa Gamma Bulletin*, *83*(1), 6 – 11.

Chalchisa, D. (2011). Continuous teacher professional development: The Ethiopian context. In *CICE 4 Africa-Asia University Dialogue for Educational Development Report of the International Experience Sharing Seminar (2): Actual Status and Issues of Teacher Professional Development*, 4 (2), 1 – 15.

Cranton, P. (2006). *Understanding and promoting transformative learning: A guide for educators of adults* (2nd ed.). San Francisco: Jossey-Bass.

Engida, M. A., Iyasu, A. S., & Fentie, Y. M. (2024). Impact of teaching quality on student achievement: student evidence. *Frontiers in Education*,9, 1367317. https://doi.org/10.3389/feduc.2024.1367317

Ennes, M., Lawson, D. F., Stevenson, K. T., Peterson, M. N., & Jones, M. G. (2021). It's about time: perceived barriers to in-service teacher climate change professional development. *Environmental Education Research*, *27*(5), 762-778. https://doi.org/10.1080/13504622.2021.1909708

Eze, E., & Nwagu, E. K. (2021). Dimensions of teachers' expressed capacity building needs on climate change education strategies. *Interdisciplinary Journal of Environmental and Science Education*, *17*(4), e2251. https://doi.org/10.21601/ijese/10982

Eze, E., Nwagu, E. K., & Onuoha, J. C. (2022). Nigerian teachers' self-reported climate science literacy and expressed training needs on climate change concepts: Prospects of job-embedded situative professional development. *Science Education*, *106*(6), 1535-1567. https://doi.org/10.1002/sce.21743

Fladerer, M. P., Drozdzewski, S., Hauser, A., Lermer, E., Kuonath, A., & Frey, D. (2023). Matching by value congruence for high-quality mentoring: evidence from a student peer mentoring program. *Studies in Higher Education*, *48*(12), 1937-1951. https://doi.org/10.1080/03075079.2023.2217441

Goerisch, D., Basiliere, J., Rosener, A., McKee, K., Hunt, J., & Parker, T. M. (2019). Mentoring *with*: reimagining mentoring across the university. *Gender, Place & Culture*, *26*(12), 1740–1758. https://doi.org/10.1080/0966369X.2019.1668752

Haßler, B., Bennett, G., & Damani, K. (2021). Teacher professional development in sub-Saharan Africa: Equity and scale. In *Embedding Social Justice in Teacher Education and Development in Africa* (pp. 18-44). Routledge.

Hudson, P. (2013). Mentoring as professional development: 'growth for both' mentor and mentee. *Professional Development in Education*, 39(5), 771–783. https://doi.org/10.1080/19415257.2012.749415

Intergovernmental Panel on Climate Change (IPCC) (2023). Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland. 1-34, 2023-07-25. https://doi.org/10.59327/ipcc/ar6-9789291691647.001

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice Hall.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge university press.

Leite, S. (2024). Towards a transformative climate change education: questions and pedagogies. Environmental Education Research, 30(12), 2376–2393. https://doi.org/10.1080/13504622.2024.2365983

Mezirow, J. (1997). Transformative learning: Theory to practice. *New Directions for Adult and Continuing Education*, 1997(74), 5–12. https://doi.org/10.1002/ace.7401

Mitchell, R., Ayinselya, R.A., Barrett, A.M, Cortez Ochoa, A.A., David, O., Imaniriho,D., Nwako, Z.A., Reda, N.W. & Singh, M. (2024). Teacher professional development in Africa: A critical synthesis of research evidence. *CIRE*, Bristol. https://doi.org/10.5281/zenodo.10944685

Onwuzurike, U. A., & Eze, E. (2022). In-service and pre-service teachers' awareness and utilisation of climate change education strategies in Teaching climate change contents in University of Nigeria, Nsukka. *Nigeria Social Science Education Review (NSSER)*, *6*(1), 28-42.

Orland-Barak, L., & Hasin, R. (2010). Exemplary mentors' perspectives towards mentoring across mentoring contexts: Lessons from collective case studies. *Teaching and Teacher Education*, *26*(3), 427-437. https://doi.org/10.1016/j.tate.2009.05.009

O'Sullivan, M. C. (2001). The inset strategies model: an effective inset model for unqualified and underqualified primary teachers in Namibia. *International Journal of Educational Development*, *21*(2), 93-117. https://doi.org/10.1016/S0738-0593(00)00026-2

Revina, S., Pramana, R. P., Bjork, C., & Suryadarma, D. (2023). Replacing the old with the new: long-term issues of teacher professional development reforms in Indonesia. *Asian Education and Development Studies*, *12*(4/5), 262-274. https://doi.org/10.1108/AEDS-12-2022-0148

Rockoff, J. E. (2008). *Does mentoring reduce turnover and improve skills of new employees? Evidence from teachers in New York City* (No. w13868). National Bureau of Economic Research. **DOI:** 10.3386/w13868

Schreiner, C., Henriksen, E. K., & Kirkeby Hansen, P. J. (2005). Climate Education: Empowering Today's Youth to Meet Tomorrow's Challenges. *Studies in Science Education*, *41*(1), 3–49. https://doi.org/10.1080/03057260508560213

Schudel, I., Lotz-Sisitka, H., Songqwaru, Z., & Tshiningayamwe, S. (2021). Engaging education for sustainable development as quality education in the Fundisa for Change Programme. *Teaching and Learning for Change*, 3-21. DOI: 10.47622/9781928502241_1

Soforon, O. G. B., Sikko, S. A., & Tesfamicael, S. A. (2023). The Understanding of Effective Professional Development of Mathematics Teachers According to South

Sudan School Context. *Education Sciences*, *13*(5), 501. https://doi.org/10.3390/educsci13050501

Teixeira, J. E., & Crawford, E. (2022). *Climate Change Education and Curriculum Revision*. World Bank. https://hdl.handle.net/10986/38146

United Nations Educational, Scientific and Cultural Organization (UNESCO). (2023). *Global report on teachers: Addressing teacher shortages and transforming the profession*. France: UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000387400

Ventista, O. M., & Brown, C. (2023). Teachers' professional learning and its impact on students' learning outcomes: Findings from a systematic review. *Social Sciences & Humanities Open*, *8*(1), 100565. https://doi.org/10.1016/j.ssaho.2023.100565

Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes, 86*. Harvard University Press.

Zhang, S., Ma, X., Xu, H. and Lu, J. (2024), The influence of mentorship in workplace on teachers' professional development a meta-analysis based on 66 experiments. *Journal of Managerial Psychology*, 39 (6), 815-831. https://doi.org/10.1108/JMP-11-2022-0588