



Towards a critical diffractive pedagogy in the teaching and learning of life sciences

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Abstract

This study advances science education by addressing the pressing challenges of the Anthropocene, an era defined by profound environmental and societal transformations driven by human activity. The research identifies a gap in existing pedagogical models, which often reproduce rather than question the assumptions that perpetuate ecological and social crises. To address this limitation, the study develops and conceptualizes Critical Diffractive Pedagogy (CDP), a framework designed to reimagine the teaching and learning of Life Sciences through critical and relational perspectives. The methodological approach involves an intra-active reading of Critical Pedagogy and Diffractive Theory, generating a theoretical synthesis that highlights the potential of education as a transformative practice. The findings reveal that CDP encourages educators and learners to engage with science as an ethical, reflective, and contextually responsive endeavor. The study's implications underscore the importance of reconfiguring science pedagogy to cultivate critical awareness, ecological responsibility, and the capacity to respond creatively to complex global challenges.

Keywords: Anthropocene; critical pedagogy; diffractive theory; life sciences education; transformative learning.

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1. INTRODUCTION

The Earth is facing a tremendous challenge due to human activities (Fernandino et al., 2018; Steffen et al., 2018; Vitousek et al., 1997). Since the Industrial Revolution, the Earth has been facing an unprecedented epoch: the Anthropocene. Human activities have pushed the earth to the edge of extinction during this period, and the effects are now felt and experienced (Hamilton, 2017; Malhi, 2017; Steffen et al., 2018). The activities during the Industrial Revolution, however, have some relationship with what was taught and learned in schools during the same period. A close analysis of education systems and pedagogical approaches during the Industrial Revolution period, for instance, reveals that education systems became streamlined to meet the demands of the expanding industrial base (Carl, 2009; Levine, 1979; Magnus, 1888). This is not isolated since, currently, for instance, education goals and outcomes are being refocused towards the Fourth Industrial Revolution (Penprase, 2018; Shahroom & Hussin, 2018; Xing & Marwala, 2017), and the same happened during the third industrial revolution (Blinder, 2006). The verdict is the same across all the industrial revolution epochs: the foundation of education has been tailored to meet the demands of the current situation. This has led to the onset and acceleration of the Anthropocene. In essence, education is complicit in the perpetuation of the ill effects of the Anthropocene. It is being charged with complicity in the onset and acceleration of the Anthropocene.

In this paper, we seek to address this problematic role of education. The paper is an attempt to come up with ways that are capable of refocusing education so as to both avert and address the effects of the Anthropocene. We locate ourselves within critical posthumanism and seek to achieve this through the development of a Critical Diffractive Pedagogy through the reading of Critical Pedagogy (CPT) with Diffractive Theory (DT).

This paper aims to provide an understanding of how the ill effects of the Anthropocene may be addressed through new pedagogical approaches in teaching and learning. Though some research has been done on ways to avert the Anthropocene (Amoureux & Reddy, 2021; Bulliet et al., 2014; Lindenmayer et al., 2014), little to nothing has been done regarding how this might be achieved through the introduction of new pedagogical approaches in education.

The discussion begins with an examination of the historical evolution of critical pedagogy. This is followed by a consideration of its significance within educational theory and practice, and an assessment of its role in the learning process. The final section presents an overview of the diffractive methodological approach, which precedes the conclusion of the paper. The application of critical pedagogy in this study recognizes the inherent tension within its humanistic foundations, particularly as they relate to the teaching and learning of Life Sciences. The focus of critical pedagogy on the interrogation of knowledge (Shor, 2002) as a pathway toward emancipation offers considerable relevance within a posthumanist framework. Engaging critically with knowledge enables educators and learners to trace and reinterpret the dynamic relations between human and nonhuman entities from a pedagogical standpoint. Consequently, critical pedagogy provides conceptual space for examining the interactions between human and nonhuman agents, a perspective that is crucial for engaging with the challenges of the Anthropocene.

1.1. Literature review

Critical pedagogy aspires to cultivate a more dialectical and reflexive orientation toward schooling. This entails fostering a multidimensional comprehension of the interplay between individual agency and structural conditions, as well as understanding how lived realities within educational spaces reflect the broader social power dynamics embedded in institutional life (Giroux, 2010). Within this framework, critical pedagogy is conceptualized as a reconstructive process through which existing social orders are interrogated and transformed (Fielding & Moss, 2012; Lichtenstein, 1985; Nyamekye et al., 2024).

1.1.1. Educational process

Aliakbari and Faraji (2011) and Richmond et al. (2024) argue that critical pedagogy introduces into

educational practice the potential for the emancipation of all individuals, irrespective of identity markers such as community, gender, or race. This perspective rests on the premise that education embodies the prevailing issues of society. In the absence of critique, educational systems risk serving as mechanisms that sustain and legitimize social inequities, prejudice, and oppression through the institutionalization of credentialism. This view aligns with Kanpol's (1998) contention that critical education must enable learners to examine, analyze, and critique the interconnections between education and society so that they can recognize and affirm their own agency as autonomous participants within the social order.

This line of thought echoes Freire's (1970) seminal critique of the "banking" model of education, which reduces learners to passive recipients of knowledge. Freire (1970) instead proposed a pedagogy of problem posing that actively interrogates the relations of power underpinning knowledge production. Drawing from the intellectual legacy of the Frankfurt School (2008), Freire (1970) recognized that education, which was originally conceived as a means of liberation, had been appropriated by dominant groups to perpetuate control and subordination. Consequently, education became a mechanism for domination and social stratification rather than a transformative practice of emancipation. This condition, Freire argued, arises when learners are subjected to banking education that reinforces conformity and passivity within an oppressive social context.

1.1.2. Politics

The relationship between critical pedagogy and politics is grounded in the conviction that educational systems are inherently shaped by the political configurations of the societies in which they operate (Freire, 1970; Freire & Macedo, 1987). Within this understanding, critical pedagogy emerges as a necessary response to the forms of subjugation and hierarchy that political structures often reproduce. Because politics inevitably governs the relations among social entities, critical pedagogy seeks to ensure that these relations do not become entrenched within educational processes in a normative or uncritical manner.

McLaren (1989) similarly argues that power and politics are inextricably embedded within education, extending even to the pedagogical level. In certain instances, political structures have imposed prevailing social orders upon educational systems, causing education to mirror the inequalities and oppressions of the wider society (Ezer et al., 2006; Zapata Barrero, 2011). By contrast, critical pedagogy strives to expose and challenge these imposed orders through the cultivation of a politics of resistance that promotes agency, equity, and transformation. This has been mentioned by Leistyna et al. (2004) below:

Critical pedagogy hopes to forge policies and institutional practices that move beyond mere accommodations and compromises to existing power structures. Social transformation of this sort happens on many levels and on many fronts. (p.11)

Leistyna et al. (2004) assert that critical pedagogy acknowledges the inherently political character of education. Freire (1985) similarly maintains that the political dimension of education arises from the imperative for learners to utilize educational processes as a means of self-emancipation and liberation. According to Freire (1985), the fullest expression of human potential is realized only when individuals are freed from conditions of oppression. Consequently, he envisions a society and a humanity founded upon principles of emancipation and liberation.

Freire (1985) further contends that achieving such a transformative vision requires a deliberate reconfiguration of discourse and the cultivation of a language that fosters tolerance, inclusivity, and an openness to changes in individual and collective consciousness. Education, in this regard, becomes the medium through which the discursive and linguistic foundations necessary for the liberation of both individuals and societies can be developed and sustained.

The political significance of critical pedagogy, beyond its connection to praxis, is also embedded in its relationship to democratic life. As Fischman and McLaren (2005) explain, critical pedagogy serves as an articulation of the practices and experiences that constitute everyday social realities:

...constructed in and through people's linguistic, cultural, social, and behavioral interactions, which both shape and are shaped by social, political, economic, and cultural forces. (p.1)

The arguments advanced by Fischman and McLaren (2005) suggest that critical pedagogy should be understood as a pluralistic framework that interrogates how educational processes are shaped by the lived and contextual experiences of both teachers and learners. These experiences are inevitably intertwined with the implicit political conditions that constitute their social environments. The radical dimension of this pedagogical stance, as articulated by Denzin (2009), lies in its capacity to unsettle the hegemonic structures that permeate conventional educational practices. Giroux and Giroux (2006) further contend that such dominant pedagogical forms frequently reproduce the ideological tendencies characteristic of neoliberal conservatism, thereby reinforcing rather than challenging existing systems of power and inequality. The views of Giroux and Giroux (2006) are clear in the following statement:

Critical pedagogy subjects structures of power, knowledge, and practice to critical scrutiny, demanding that they be evaluated in terms of how they might open up or close down democratic experiences. (p.1)

Denzin (2009) and Giroux and Giroux (2006) concur that critical pedagogy must confront and dismantle the hegemonic structures sustaining oppressive forms of education by revealing their underlying foundations. The necessity for a radical orientation within critical pedagogy, as further elaborated by Giroux and Giroux (2006), lies in its potential to transform educational experiences and practices. They contend that embracing radicalism within critical pedagogy establishes the groundwork for cultivating critical literacy. This form of literacy carries profound significance because it enables individuals to recognize and question mechanisms of control and subjugation, whether these operate through overt physical dominance or more subtle psychological means.

Grounded in its radical framework, critical pedagogy emerges as a pedagogy of resistance, conscientization, and emancipation. Conscientization functions as a response to the implicit political forces that shape consciousness, whereas emancipation challenges the entrenched systems of domination perpetuated by political institutions within society. Denzin (2009) asserts that critical pedagogy should furnish the analytical and transformative tools necessary to reconfigure the ways identity, agency, and citizenship have been constrained within neoliberal ideology. Ulmer (2019) similarly proposes that critical pedagogy ought to be understood as a discursive practice that represents and reconstructs reality through textual engagement, with such reality grounded in the lived experiences of both learners and educators. In this sense, critical pedagogy seeks to unveil and interrogate the distorted realities and identities that have been normalized and reinforced by educational systems operating under neoliberal influence.

1.1.3. Curriculum

The relationship among curriculum, authentic material, and critical pedagogy is multifaceted and intricate. As observed in the literature (Giroux, 2023; Shor, 2002; Yespolova et al., 2025; Uzunboylu & Altay, 2021), critical pedagogy maintains that the curriculum should not be regarded as a fixed or immutable text. Rather, it should be continuously shaped by the lived experiences, needs, and encounters of learners. When these contextual elements are disregarded, the curriculum risks becoming a collection of externally imposed experiences that fail to resonate with learners' realities. Hence, there is a pressing need to achieve a balance among these interrelated components. Degener (2001) argues that such an equilibrium can be realized only when the curriculum is closely connected to learners' experiences and does not estrange them from the social and cultural contexts that serve as the origins of their understanding. Lankshear and McLaren (1993) similarly emphasize that critical pedagogy attains its full potential when it engages with the cultures of learners, encourages active participation, and promotes social empowerment. In contrast, an uncritical and non-transformative pedagogy that neglects the social conditions of marginalized learners perpetuates exclusion (Macedo, 1994). Transformative learning, therefore, equips learners to comprehend how their social realities are structured by relations of power and enables them to act as agents of change.

Authentic material serves as a central component of transformative learning, used by both teachers and learners to facilitate critical engagement. As Kessing-Styles (2003) explains, authentic materials should allow learners to analyze their everyday experiences through the lens of oppression and inequality. Even in instances where direct connections are absent, learners should still be encouraged to examine the contexts within which

such experiences have occurred or might occur. This process enables them to interrogate unfamiliar experiences and develop forms of resistance (Kincheloe, 2005; Okazaki, 2005). Ares (2006) notes that this critical engagement fosters momentum that empowers learners to challenge and resist oppressive systems.

1.1.4. The role of the teacher and learner

The role of the teacher is central to the advancement of critical pedagogy. Kincheloe and McLaren (1994) argue that teachers must move beyond the transmission model of banking education by enabling learners to recognize and criticize the oppressive effects of social stratification. A teacher who fails to cultivate such awareness risks becoming a complicit agent in perpetuating subjugation by reinforcing the interests of dominant groups. Sadeghi (2008) further asserts that teachers should nurture learners' capacity to articulate their voices and integrate these voices into the learning process. Teachers should function as transformative intellectuals who merge their own experiences with those of learners, fostering a dialogical environment in which knowledge is co-constructed. Freire (1973) maintains that such dialogical engagement transforms learners into active and progressive participants in their own educational development, rendering the banking model of education obsolete.

The teacher's primary function is to foreground the development of agency among learners, an agency that enables them to critically interrogate their realities and examine how these align or diverge from their educational experiences. Horton (1990) likewise observes that the teacher's engagement with critical pedagogy is fundamental to nurturing critical agency. Both Horton (1990) and Freire (1973) highlight the co-constructivist nature of this interaction, which serves as a safeguard against the passive accumulation of knowledge characteristic of traditional instruction.

Critical pedagogy should therefore equip learners with the means to transcend their immediate circumstances and envision alternative possibilities for action. Guthrie (2003) refers to this as the development of co-agency, a relational process that links the agency of teachers and learners with the broader learning context and content. Teachers facilitate this process by empowering learners to generate agency from within themselves, thereby enabling them to challenge forms of oppression and inequality.

Kincheloe (2005) underscores the ethical and political dimensions of this relationship, suggesting that critical pedagogy must function as a conduit for justice and equality within education. This is achievable only when teaching directly confronts societal inequities and fosters critical consciousness. Kincheloe implies that learning should engage the specific challenges learners face, encouraging them to situate their experiences within larger social and political frameworks. Learning, in this sense, becomes both a process of acquiring knowledge and a reflective act of questioning its relevance, legitimacy, and applicability.

1.1.5. Equality and participation

Generally, at its core, critical pedagogy seeks to eliminate inequality and marginalization. Freire (1970) emphasizes that its ultimate goal is the restoration of the suppressed voices and identities of the oppressed, empowering them to reclaim agency and self-expression. According to Freire (1970), teaching that neglects this process merely perpetuates the banking model of education. Genuine learning occurs when learners develop an awareness of their identities and the social issues that shape their lived experiences. The recovery of voice and identity thus becomes a vital element in the educational process, fostering learners' transformation into agents of social change.

Learners not only demand change but also become integral to the process of transformation through the development of active agency. They engage in reflective analysis of their positions within society, mapping the trajectories of their lives to uncover the structural and historical forces that have contributed to their current conditions. This reflective tracing exposes the intersections and entanglements that have shaped their identities and realities. Degener (2001) asserts that when learners achieve such contextual understanding, they gain the capacity to prevent the recurrence of similar patterns of oppression in the future.

1.1.6. Critical Consciousness

Freire (1973) identifies the cultivation of critical consciousness as the highest achievement of critical

pedagogy. By prioritizing critical consciousness, critical pedagogy becomes a mechanism for the enactment of praxis. Freire (1970) defines praxis as the synthesis of reflection and action: reflection enables learners to interpret their experiences, while action involves the implementation of insights derived from that reflective process. Kessing-Styles (2003) reiterates that praxis allows learners to view reality as fluid and dynamic rather than fixed, thereby transforming intellectual engagement from abstract theorizing into experiential practice aimed at addressing real-world issues. Praxis also integrates dialogical interaction into learning, facilitating co-agency and the collaborative creation of meaning (Sadeghi, 2008).

Cho (2012) contends that critical pedagogy introduces egalitarian forms of power relations designed to amplify and strengthen previously silenced voices, particularly those of learners. The overarching purpose of critical pedagogy, according to Cho (2012), is to inspire and cultivate critical consciousness as a fundamental value for social transformation. In this respect, critical pedagogy seeks to recover the muted and marginalized voices, ensuring that each contributes meaningfully to the process of learning. To fulfill this purpose, critical pedagogy must engage profoundly with educational realities and nurture a critical imagination that encourages both teachers and learners to question the assumptions underpinning teaching and learning. By fostering critical imagination, education can move beyond routine practices, enabling an expansive inquiry into the roles of teachers, learners, curricula, and the broader society.

2. METHOD AND MATERIALS

This study employed a theoretical and conceptual research design grounded in qualitative inquiry. Using an intra-active and interpretive approach, the researcher conducted an analytical reading of two major frameworks, Critical Pedagogy and Diffractive Theory, to develop a synthesized model termed Critical Diffractive Pedagogy (CDP). The methodology involved identifying and interweaving key themes from both traditions, allowing their concepts to diffractively inform and transform one another rather than being treated as separate or oppositional. Through this iterative and reflective process, the study conceptualized CDP as a framework that reimagines Life Sciences education through critical, relational, and ethical perspectives. This theoretical synthesis served not only to articulate the philosophical underpinnings of CDP but also to illuminate its pedagogical affordances in cultivating ecological consciousness, critical reflection, and transformative learning within science education.

3. RESULTS

3.1. Diffractive methodology

The concept of diffraction, understood both as a pedagogical framework and as an analytical instrument, was initially introduced by Haraway (1992). In her formulation, Haraway (1992) presents diffraction as a theoretical and methodological response to her critique of reflexivity, which she viewed as insufficient within the domain of critical social science. The subsequent evolution of the concept from a theoretical proposition into a distinct analytical approach is articulated more explicitly in Haraway's later work (1997), where she elaborates on the philosophical and methodological implications of diffraction:

Reflexivity has been recommended as a critical practice, but I suspect that reflexivity, like reflection, only displaces the same elsewhere, setting up worries about copy and original and the search for the authentic and really real. Diffraction is an optical metaphor for the effort to make a difference in the world. Diffraction patterns record the history of interaction, interference, reinforcement, and difference. Diffraction is about heterogeneous history, not about originals. Unlike reflections, diffractions do not displace the same elsewhere, in more or less distorted form. Rather, diffraction can be a metaphor for another kind of critical consciousness at the end of this rather painful Christian millennium, one committed to making a difference and not to repeating the Sacred Image of Same. Diffraction is a narrative, graphic, psychological, spiritual, and political technology for making consequential meanings. (p.71-72)

In her elaboration of the concept of diffraction, Haraway explains that although diffraction and reflection differ in their physical properties, diffraction possesses dimensions that extend beyond what reflection can offer. She observes that diffraction is oriented toward recognizing and tracing patterns of difference as they emerge and interact across phenomena. Philosophically, this orientation toward difference is highly

significant, as it provides a means of understanding how variations among entities can combine and evolve, generating new and complex forms of differentiation. The cumulative interplay of these variations produces multidimensional diversity and underscores the interwoven nature of entities, leading to the recognition of relationships that are simultaneously affective and effective.

Haraway (1992) further develops the notion of difference as a central analytical parameter within diffraction. She conceptualizes difference as an intrinsic quality embedded in the constitution of all entities, one that possesses a transitive and dynamic nature, enabling transformation while preserving its essential role in generating diversity. Haraway (1992) cautions against interpreting difference in taxonomic or categorical terms, as doing so risks reinforcing separation and hierarchy. Instead, she proposes that difference should be understood as a relational force through which entities can be apprehended in relation to one another. In this sense, Haraway (1992) substitutes critique with diffraction, positioning the latter as a practice that actively produces difference rather than merely identifying or evaluating it. Difference, therefore, functions as a generative principle of diversification, giving rise to further differences that are both outcomes and catalysts of ongoing relational processes:

Crucially, diffraction attends to the relational nature of difference; it does not figure difference as either a matter of essence or as inconsequential: a diffraction pattern does not map where differences appear but rather maps where the effects of differences appear. (p.300)

In this context, Haraway underscores another essential feature of diffraction, its focus on the relational constitution of difference. She emphasizes that difference should not be perceived as an isolating or discrete attribute but rather as a relational dynamic through which entities come to exist and interact by means of one another.

Expanding upon Haraway's conceptualization, Barad (2007) rearticulates diffraction as an analytical practice concerned with tracing the material and discursive effects of difference. For Barad, diffraction is both constituted by difference and generative of it, simultaneously reflecting and producing the relational patterns through which phenomena emerge. Barad (2007) explains this position as follows:

In fact, I will argue that there is a deep sense in which we can understand diffraction patterns - as patterns of difference that make a difference - to be the fundamental constituents that make up the world. (p.72)

Barad (2007) contends that the very constitution of the world arises from the continual manifestation of differences that permeate all entities. From this perspective, reality itself can be understood as a convergence of overlapping differences that perpetually generate new forms of differentiation. Barad (2007) further argues that diffraction should not be viewed solely as an instrument for examining the consequences of difference but also as a phenomenon that actively reveals the depth of ontological entanglement underlying existence. In this sense, diffraction functions as both a methodological tool and an ontological condition that illuminates the interconnectedness inherent within the material world.

Through this interpretation, Barad (2007) suggests that viewing the world through a diffractive lens displaces dichotomous thinking, encouraging an understanding of differentiation as a dynamic process akin to the movement of waves producing patterns of interference. Diffraction, therefore, does more than expose the degree of entanglement among entities; it discloses the extent to which the world itself constitutes an entangled and co-constitutive phenomenon.

Barad (2007) also emphasizes that the effective application of diffraction requires the identification and calibration of a diffractive apparatus. She explains that for diffraction to operate meaningfully, the apparatus must be sensitively aligned with the specificities of the phenomenon under examination. This framing suggests that a diffractive apparatus functions as a methodological configuration through which the process of diffraction is enacted. Consequently, the practice of diffraction must be adapted to the particular conditions of inquiry, ensuring that the apparatus is responsive to the contextual nuances of the phenomenon being studied. Barad (2007) affirms this position as follows:

"The analysis at hand then will require thinking through the details of diffraction as a physical

phenomenon, including quantum understandings of diffraction and the important differences they make, to tune the diffraction apparatus, to explore the phenomenon at hand, which in this case is diffraction, to produce a new way of thinking about the nature of difference, and of space, time, matter, causality, and agency, among other important variables. (p.73)"

Barad (2007) introduces the concept of diffraction by first engaging with its classical physical interpretation. She defines diffraction as the process through which waves intersect and interact, thereby producing distinctive patterns of interference. Barad (2007) further explains that diffractive patterns arise when waves encounter one another, creating zones of intensified and diminished energy as a result of their interaction. Barad (2007) elaborates on this dynamic as follows:

Waves can overlap at the same point in space. When this happens, their amplitudes combine to form a composite waveform. For example, when two water waves overlap, the resultant wave can be larger or smaller than either component wave. For example, when the crest of one wave overlaps with the crest of another, the resultant waveform is larger than the individual component waves. On the other hand, if the crest of one wave overlaps with the trough of another, the disturbances partly or in some cases completely cancel one another out, resulting in an area of relative calm. Hence, the resultant wave is a sum of the effects of each component wave; that is, it is a combination of the disturbances created by each wave individually. This way of combining effects is called superposition. (p.76)

In the preceding excerpt, Barad (2007) offers a detailed account of how diffraction operates as a physical and conceptual process. Comprehending this mechanism is essential for appreciating its pedagogical potential. From a pedagogical standpoint, diffraction may be conceived as the progressive superimposition of multiple effects that interact to generate new and emergent outcomes. In this sense, diffraction can be understood as a form of interference produced through the intersection and accumulation of various effects, each contributing to the creation of novel patterns of meaning and understanding.

3.2. Diffraction as a methodology

Expanding upon her theoretical exposition, Barad (2007) proposes that diffraction should be approached as a critical and inclusive methodological practice. She conceptualizes it within the framework of agential realism, which emphasizes the performative nature of analysis and interpretation. This framework challenges binary modes of thinking and calls for the integration of diverse forms of knowledge-making practices. According to Barad (2007), the agential realist foundation of diffraction rests on the understanding that both material and immaterial practices are bound together through processes of intra-action that occur within, and as part of, the world itself. In her own words, Barad (2007) articulates this idea as follows:

We do not uncover pre-existing facts about independently existing things as they exist frozen in time, like little statues positioned in the world. Rather, we learn about phenomena - about specific material configurations of the world's becoming. The point is not simply to put the observer or knower back in the world (as if the world were a container and we needed merely to acknowledge our situatedness in it) but to understand and take account of the fact that we too are part of the world's differential becoming. (p.90-91)

Barad's (2007) articulation of diffraction draws attention to a central conceptual theme, the notion of differential becoming. This idea suggests that entities are defined by a continual process of transformation that is fluid and dynamic, emerging through their intra-actions with other entities. The theme of differential becoming broadens the scope of diffraction to include the ontological interrelations between human and nonhuman entities and the world they inhabit. Within this framework, the agency of entities is not fixed or self-contained but rather contingent upon their ongoing intra-actions with one another and with the material and discursive environments that surround them. These intra-actions follow patterns that may be described as interferential, producing effects that are simultaneously relational and transformative. Consequently, all encounters can be regarded as diffractive, as they arise from and contribute to configurations and reconfigurations of entities through continuous intra-activity.

In further elaborating her account of diffraction, Barad (2007) introduces another important dimension:

the interconnection between material and immaterial entities. She emphasizes that all immaterial practices, including knowledge itself, exert material effects. Barad (2007) illustrates this point through the example of knowledge as a non-physical phenomenon that nevertheless generates tangible outcomes through its entanglement with the practices of knowing. It is through the materiality of these epistemic processes that the world becomes reconfigured and reconstituted. Barad (2007) articulates this view in the following statement:

Making knowledge is not simply about making facts but about making worlds, or rather, it is about making specific worldly configurations in the sense of making them up ex nihilo, or out of language, beliefs, or ideas, but in the sense of materially engaging as part of the world in giving it specific material form. And yet the fact that we make knowledge not from outside but as part of the world does not mean that knowledge is necessarily subjective (a notion that already presumes the pre-existing distinction between object and subject that feeds representationalist thinking). (p.91)

In this statement, Barad (2007) conceptualizes diffraction as an active process of world-making that emerges through material engagement. Within this framework, both the maker and the world are not regarded as pre-existing entities but as co-constituted through their ongoing intra-actions. Barad (2007) asserts that the formation of worlds through such processes cannot be understood as a purely subjective act, since it involves the interplay of multiple entities whose intra-actions transcend individual intentionality. At the same time, she argues that diffraction should not be understood as objective in the conventional sense. Instead, she redefines objectivity as an ethical and ontological responsibility toward our intra-actions with the world, which we simultaneously inhabit and help to constitute. This perspective reaffirms the earlier view that diffraction resembles a wave-like phenomenon characterized by continuous fluidity and an endless series of intra-actions among entities. These intra-actions are inherently productive of difference, both emerging from and generating difference in the process of their occurrence.

3.3. Towards understanding diffraction from a pedagogical perspective

From a pedagogical standpoint, it is important to consider the implications of Barad's (2007) understanding of diffraction for teaching and learning practices. The concept that carries the strongest pedagogical significance is that of dynamic relationality. In this sense, the waveform of diffraction embodies a pattern of iterative boundaries that are simultaneously material and discursive yet remain flexible and continuously reconfigurable. Barad (2007) affirms this in the following statement:

My method of diffraction is to engage aspects of each in dynamic relationality to the other, being attentive to the iterative production of boundaries, the material-discursive nature of boundary-drawing practices, the constitutive exclusions that are enacted, and questions of accountability and responsibility for the reconfigurings of which we are a part. That is, the diffractive methodology that I use in thinking insights from different disciplines (and interdisciplinary approaches) through one another is attentive to the relational ontology that is at the core of agential realism. (p.93)

The concept of iterative boundaries discussed above is central to the pedagogical application of diffraction theory. The iterative quality of such boundaries provides the foundation for employing diffractive analysis in exploring how particular subjects may be taught. According to Barad (2007), the value of a diffractive methodology lies in its refusal to accept the existence of fixed or predetermined boundaries between entities. Diffraction, therefore, offers a framework that facilitates engagement across disciplinary terrains. As Barad (2007) notes, a diffractive approach remains deeply sensitive to the specificities and intricacies that characterize distinct disciplines. Through this attentiveness, it enables pedagogical inquiry that moves across disciplinary domains, or, as Barad (2007) previously suggests, permits the examination of one discipline through the interpretive framework of another. Moreover, Barad (2007) emphasizes that the distinctive significance of diffractive pedagogy resides in its focus on the material-discursive processes involved in boundary formation among entities. Such processes are indispensable for understanding the relational interplay between materiality and immateriality, which forms a central tenet of diffractive inquiry. This is reflected in the following statement by Barad (2007):

What is needed are respectful engagements with different disciplinary practices, not coarse-grained

portrayals that make caricatures of another discipline from some position outside it. My aim in developing a diffractive methodology is to attempt to remain rigorously attentive to important details of specialized arguments within a given field without uncritically endorsing or unconditionally prioritizing one (inter)disciplinary approach over another. (p.93)

In the statement above, Barad (2007) further underscores the importance of cultivating respectful engagements when examining the boundaries that exist among entities. This argument implies that diffraction, understood as the interweaving and enfolding of boundaries, should unfold in a manner that neither privileges nor subordinates certain boundaries over others. Rather, it should aim to identify and operate from the shared grounds that facilitate the assimilation, negotiation, and transformation of the differences inherent within all entities, thereby generating new and emergent configurations of boundaries.

Barad (2007) further argues that this ethic of respectful engagement encourages the development of critical reflection concerning the operations of relationality among entities. Recognizing relationality among entities traditionally conceived as discrete or non-relational effectively destabilizes and dissolves the rigid boundaries that have long separated them. As a result, the conventional distinctions between interiorities and exteriorities that typically characterize entities are transcended, giving rise to a more fluid and dynamic understanding of intra-active relations. Barad (2007) encapsulates this position in the following statement:

This diffractive methodology enables me to examine in detail important philosophical issues, such as the conditions for the possibility of objectivity, the nature of measurement, the nature of nature and meaning-making, the conditions for intelligibility, the nature of causality and identity, and the relationship between discursive practices and the material world. (p.94)

Following an extensive review of the literature on diffractive methodology, several key themes have emerged. These themes will be read diffractively alongside those identified within the discourse of critical pedagogy to construct the framework for a Critical Diffractive Pedagogy. The identified themes include:

- Egalitarian power relations
- Promotion of change
- Minoritarian attitude
- Engagement

The subsequent section provides a detailed discussion of each of these themes and their implications for the development of a Critical Diffractive Pedagogy.

3.4. Towards critical diffractive pedagogy

At the outset of this study, the objective was established as the formulation of a Critical Diffractive Pedagogy (CDP). This conceptual framework is constructed through the integration of key elements drawn from both Critical Pedagogy Theory (CPT) and Diffractive Methodology Theory (DMT). CDP rests upon the interrelation of critical and diffractive perspectives in teaching and learning, where each concept informs and enriches the other.

3.5. Engagement

As CDP rests upon the interrelation of critical and diffractive perspectives in teaching and learning, where each concept informs and enriches the other. A critical orientation in this context involves the interrogation of barriers such as race and language that are embedded within diffractive processes. Such interrogation entails an ongoing engagement with educational situations, encouraging multiple layers of interpretation and analysis.

This form of engagement inherently challenges the dominance of established norms and systems, thereby fostering spaces of resistance. Within CDP, this resistance manifests as an emphasis on sustained critical dialogue. Rather than confronting opposing views through antagonism, critical dialogue seeks to engage diverse perspectives in open and fluid exchanges, where pre-established boundaries are not treated as immutable but as sites for potential reconfiguration. The dynamic relationship between entities, as articulated

by Barad (2007), resembles a continually shifting wave generated through processes of intra-action.

Through this diffractive process, dialogue disrupts hierarchical centralities, exposing entities to reciprocal transformation and producing new relational configurations. Consequently, CDP embodies a form of resistance that is both permissive and persuasive. Resistance is conceived not as oppositional defiance but as a mode of negotiation that maintains difference while preventing domination. This negotiation enables entities to coexist as partners in difference, thereby sustaining diversity through complementary relations rather than a homogenized consensus.

From a pedagogical perspective, CDP anticipates and mediates the tension between curricular frameworks and the dynamic realities of educational contexts. It advocates for the cultivation of engagement through critical dialogue as a means of softening rigid separations between polarized domains, thereby generating spaces for relational understanding and transformative learning.

3.6. Egalitarian power relations

CDP rejects binary constructions of positionality and seeks instead the establishment of egalitarian power relations. Recognition of the ways in which dominant systems perpetuate hierarchies of power is regarded as an essential step toward dismantling them. This recognition facilitates the creation of spaces that level existing asymmetries, thereby rendering power a collectively accessible and democratically distributed construct. Such an approach promotes the decolonization of status positions and privileges associated with the maintenance of the status quo.

The pursuit of egalitarianism in CDP aligns with the principles of entanglement and differential becoming. Differential becoming is defined by open and dynamic subjectivities that enable relational interconnectedness among entities. This open subjectivity encourages the aggregation of individual differences into a collective multiplicity, fostering diversity within communal structures. In conjunction with this process, open subjectivity enhances entanglement by allowing entities to move beyond dichotomous boundaries and interact in mutually constitutive ways. These movements dissolve rigid separations and facilitate collaborative transformation among interconnected elements.

3.7. Promotion of change

The theoretical foundation of CDP is also characterized by an inherent orientation toward transformation. The promotion of change underscores the necessity of upholding diversity and recognizing all entities as equal participants in the collective. Acknowledging change as a defining element of relational existence emphasizes the central role of contextual justice in pedagogical models that integrate criticality with diffraction.

An educational system that embraces change inherently resists predetermined categorizations of entities. Such resistance safeguards equality and democratic participation within collective structures. The promotion of change, therefore, functions as a mechanism for ensuring that pedagogical practices remain responsive to evolving contexts and open to continual redefinition in pursuit of justice and inclusivity.

3.8. Minoritarian attitude

CDP further advances the notion of a minoritarian attitude within relational collectives. The significance of this orientation lies in its potential to facilitate reciprocal transformation among identities traditionally differentiated by power and privilege (Deleuze, 1991). By contesting hierarchical distributions of influence, the minoritarian attitude redefines power as a relational rather than quantitative concept. The minority is thus identified not by numerical inferiority but by its position of subjugation, even when numerically dominant.

A minoritarian perspective emerges when dominant structures are disrupted, compelling them to relinquish the authority of self-defined representational norms. Through this disturbance, the dominant position undergoes its own transformation, igniting the minoritarian potential within itself (Zehavi, 2010). Within this framework, CDP broadens the democratic imagination, aligning it more closely with principles of social justice and diffractive interconnection rather than majoritarian representation.

This orientation calls for the inclusion of all perspectives within pedagogical practice without recourse to

dichotomization. Entities frequently marginalized within educational and social contexts, such as women, people of color, economically disadvantaged groups, the nonliving, and the nonhuman, are afforded equal dignity within the pedagogical collective. By adopting a minoritarian attitude, CDP reconfigures the conditions of relationality, enabling the emergence of new standards for coexistence grounded in equality, diversity, and interdependence.

4. CONCLUSION

The Critical Diffractive Pedagogy (CDP) emerges as a theoretically integrated framework that reimagines educational practice through the mutual entanglement of criticality and diffraction. The approach reconceptualizes teaching and learning as relational processes in which knowledge, power, and identity continuously intra-act rather than exist as fixed or oppositional entities. Through this entanglement, CDP offers a pedagogical paradigm that resists static binaries and cultivates dynamic relationality.

The four foundational themes, egalitarianism of power relations, promotion of change and social justice, minoritarian attitude, and engagement, collectively articulate the philosophical architecture of CDP. The egalitarian approach to power dismantles hierarchical boundaries that sustain educational inequality, transforming power into a shared and participatory force. The promotion of change underscores the necessity of openness and adaptability within educational systems, ensuring that pedagogy remains responsive to shifting sociocultural realities. The minoritarian attitude challenges majoritarian dominance by reconfiguring marginality as a generative and transformative site of knowledge production. Engagement, positioned as both method and ethos, anchors these processes in dialogic exchange, enabling learning environments that are relational, inclusive, and ethically attuned.

Through the integration of these elements, CDP positions education as an ongoing diffractive process of becoming one that privileges connection over separation, dialogue over confrontation, and transformation over reproduction. The theory advances a vision of pedagogy that does not seek closure or consensus but instead values the productive tensions and differences that sustain diversity within collective educational spaces. In this sense, CDP contributes to the broader project of rethinking pedagogy as an ethical, critical, and ontologically open practice that continually reconfigures the relationships among knowledge, subjectivity, and the world.

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