ISSN: 2717-5081 (Print); 2738-9529 (Online)

Journal of Transformative Praxis

Volume 1, Issue 1, June 2020

Kathmandu University (KU), Tribhuvan University (TU) and the Norwegian University of Life Sciences

https://www.kusoed.edu.np/journal/index.php/jtp

Journal of Transformative Praxis

Volume 1, Issue 1, June 2020

A Publication
of
Kathmandu University (KU), Tribhuvan University (TU)
and the Norwegian University of Life Sciences

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The Journal of Transformative Praxis is hosted and published quarterly through a collaborative venture among Kathmandu University (KU), Tribhuvan University (TU) and the Norwegian University of Life Sciences (NMBU), under the NORHED-financed *Rupantaran* project. This journal is a scholarly forum and publishes double blind peer-reviewed manuscripts where scholars critically and reflexively engage on multi-epistemological approaches as a participatory (and practitioner) metaphor of action, reflection, and transformation. In particular, the journal aims to address the nexus between education, health, and livelihoods in society, appreciating, especially the immediate contexts of inquiry and emphasizing progress through recognition of the primacy of local settings in Asian and other similar contexts.

Social-progress frameworks such as the United Nations' Sustainable Development Goals (SDGs) emphasize quality education, gender equality, healthy lives, and peaceful and inclusive society. More socially driven research on education provides a foundation for achieving social goals as mentioned above. Furthermore, the health of individuals and their surroundings (human landscapes) ultimately affect both their livelihoods and their education and knowledge production. Therefore, there is seemingly a close association of health and livelihoods in education. Acknowledging such interconnectedness, this journal focuses on transformative praxis of individuals to bring change in education, health and livelihoods, particularly informed through one's first-hand, especially lived and embodied (bodily) experiences.

In recent years, particularly within the public health and education sectors, there has been a burgeoning growth of interest in the use of practitioner-research approaches (e.g., participatory action research, self-study, auto/ethnography, etc.) that aim at substantial revision of existing ways of observing a phenomenon and acting and reflecting on it. Research projects using these approaches are framed as action research, collaborative participation, reflective action, and transformative learning. They are considered to be promising for advancing understandings pertaining to critical social sciences, particularly in the education and public health domains.

Present-day academics have in one way or another experienced battles between positivist and non-positivist research methods, most of them ascribing greater importance and/or to legitimizing one side against the other, leaving less room for discourses on mixed- and multi- paradigmatic practices that seek to bring together different approaches, including action, reflection, and transformation. The Journal encourages broader application of varieties and critical-creative variations of positivist, non-positivist, mixed, and multi-paradigmatic (including multi-methods and methodologies), as appropriate.

It is now widely acknowledged that the beliefs and experiences on which these approaches are based are not a homogenous field; therefore, the epistemological, psychological, pedagogical, and political dimensions of these approaches should be brought into discussion and critical awareness-raising. To this end, aimed at advancing practitioner-research methods and approaches, this journal seeks to provide a platform that brings together action-informed experiences from both the Global North and Global South. The Journal envisions facilitating pragmatic discussions related to dialogical and dialectical interplay that is inherently involved when applying diverse approaches.

Practitioner-research often stems from an individual's (or practice community's) systematic reflection on their own practice (action) in order to improve it. The participatory element of action research draws the researcher and the community where research is conducted together in partnership, or quest, to create sustainable change on an issue of interest to both parties. The imperative for such change through investments in socially

transformative action affords methodological and perspectival structures that fundamentally address research circumstances.

Further, when practicing researchers call into question their taken-for-granted assumptions and frames of reference, thereby generating more empowering beliefs and informed actions, praxis-induced transformative learning experiences can take place. When exposed to transformative learning experiences, habits of mind are shaken, questioned, or rejected, creating space for more informed actions. Thus, in social research, the use of action research, reflective practice, and transformative learning seek to complement one another, where transformative praxis constitutes their meeting point.

With the above points in mind, the Journal encourages scholars to advance transformative praxis by bringing action and reflection together. The journal seeks to promote reflective practitioners who can help the larger academic community realise the need for using research as a means for affecting informed change and moving outside of comfort zones of individual researchers and their departments/disciplines.

Such transformative praxis through practitioner-research approaches, however, is not free from the manifold dilemmas arising from multidisciplinary or transdisciplinary methodological challenges, relationality, ethics of voices, paradoxes of opening communicative space, and etic-emic perspectives, to name but a few. Through reflective dialogues on these epistemic prospects and challenges as experienced in practitioner research and reflective practices, which we put forward together as transformative praxis, this journal aims to create a wide forum for academic discussions in the areas of education, health, and livelihoods.

In this context, the Journal publishes manuscripts from researchers and practitioners to explore the prospects of transformative education research and practice. Themes authors could focus on include (but are not limited to):

- Teaching and learning in primary and higher education
- Teacher professional development
- Project-based, inquiry-based, arts-based pedagogy
- Integration of STEAM pedagogy
- Water, health, sanitation, and hygiene in schools and communities
- Nutrition, gardening, and technical skills in school curricula
- School health education
- Community-based participatory research to improve health and education outcomes
- Critical place inquiry, indigenous, de-colonial and postcolonial research methodologies in health and education
- Research as praxis
- Praxis-informed transformative knowledge and practices
- Multi-paradigmatic research and methodological pluralism
- Remodeling action research theories and practices in local contexts
- Towards inclusive and sustainable practices for community development
- Researchers' contextual experiences in the building of alliances between researchers and research participants
- Ethical dilemmas and quality issues researchers experience in engagement with practitioner-research approaches
- Strengthening rural women's livelihoods
- Social inclusion, including gender and disability
- Social entrepreneurship
- Sustainable happiness, peace, wellbeing and spiritual ecology

Inquiry and Comment

For any general questions and comments about the double-blind peer-review process, the Journal or its editorial policies, we encourage to contact us at jrtp@kusoed.edu.np.

Editorial

Original Articles

Open Access

Journal of Transformative Praxis

Vol. 1, No. 1, 2020, pp. 1-8

DOI: https://doi.org/10.3126/jrtp.v1i1.31756

Editorial

Conceptualising Transformative Praxis

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Abstract

Transformative praxis covers a wide range of scholarly pursuits for social change via reflexive research and practice. Praxis is used to raise the consciousness of researchers, participants and social actors through a constant embracing of a critical stance toward text, discourse, and the lifeworld. A host of images are used to conceptualise the notion of transformative praxis as epistemology, theory, methodology, professional development, genres and logics, and empowerment. Transformative praxis as epistemology refers to multiple ways of knowing embedded in critiquing, reconceptualizing self, and envisioning; whereas transformative praxis as theory is informed by the critical scholarship of strengths and limitations of theories, philosophies, and perspectives as a means for social change. Our ideas of transformative praxis as methodology are embedded in the commitments of researchers and practitioners to engage in the process of holistic meaning making. Reflexive engagement of researchers and practitioners in the lifeworld contributes to the conceptualisation of transformative praxis as professional development. Transformative praxis as empowerment draws upon the ongoing discourse of an emancipatory interest that emphasises autonomy, responsibility, and criticality. The articles in this issue focus on developing cosmologically responsible educational processes, deviance as pedagogical action, holistic learning, and pedagogical change through multiparadigmatic research processes.

Keywords: *Praxis. Logics and genres. Reflexivity. Emancipation*.

Introduction

Our notion of transformative praxis covers a wide range of scholarly pursuits of social change, such as developing educational programs, addressing humanitarian crises, and implementing culturally responsible pedagogies (Navarro, 2018). Methodologically, transformative praxis aligns with reflexive research traditions arising from participatory action research, arts-based research, transformative mixed methods, critical policy research, narrative research, and autoethnographic inquiry, to name but a few. In these methodologies,

 ISSN: 2717-5081 (Print); 2738-9529 (Online)

praxis is used to raise the consciousness of researchers, participants and actors by following a sequence of actions and critical reflections (Maseko, 2018). The goal of such research methodologies is not only to find answers but to gain insights into processes and outcomes of research and practice through critical and reflective knowledge production. Transformative praxis is thus characterized by recursive "reflections and action upon the world in order to transform it" (Freire, 2005, p. 36). Owing to the great diversity of contexts, practices and people, there is no single and prescribed technique for transformative praxis, apart from the goal of cultivating the critical conscience of researchers, practitioners, participants and actors through ethical and participatory engagement in the lifeworld. Developing transformative praxis demands a constant need to embrace a critical stance toward text, discourse, and the lifeworld to change our practices and systems in favour of social justice, equity, and inclusion (Hyslop-Margison & Dale, 2010). We hold the view that practitioners with transformative sensibilities play a crucial role in examining their own beliefs, assumptions, and activities to improve their actions for creating better systems and practices (Berryman, 2013). Active engagement and dialogue with fellow members of the community of practice is the first necessary step for transformative praxis (Pillay, 2015). Developing a sense of agency and collegiality among members of the community of practice contributes to the sustenance of the process of transformative praxis, which is akin to change through a sequence of action and critical reflection. In this way, the process leads toward an envisioning of existing practices in the direction of promoting socially just and equitable systems (Maseko, 2018). As the notion of transformative praxis for both researchers and practitioners cannot simply be reduced to discrete action and reflection, this editorial discusses the notion via the following images of transformative praxis as/for epistemology, theory, methodology, professional development, genres and logics, and empowerment.

Epistemology

For us, the Journal is grounded in the idea of multiple ways of knowing, such as critiquing, reconceptualizing self, and envisioning (Luitel, 2018). The epistemic metaphor of critiquing enables researchers and practitioners to explore disempowering practices, cultures, and systems present in self and others. The idea of transformative praxis as epistemology is further enhanced by the image of knowing as reconceptualizing self which puts primacy on examining the deep-seated values, beliefs, and perceptions of researchers and practitioners, with a view to morph their situatedness as change agents. This examination allows a cognitive-aesthetic shift from practitioners and researchers as passive consumers of metanarratives to active artist creators of inclusive social realities (Granger, 2006; Mukhopadhyay, 2019). The epistemic metaphor of knowing as envisioning allows researchers and practitioners to imagine inclusive and empowering futures through a humane approach to establishing an active connection between the transpired, ongoing, and emergent. We echo Maxine Greene's idea that such imagining would not be error-free, for an active exercise of vision making is less about error and more about our commitment to change (Greene, 1995).

Theory

Our formulation of transformative praxis as theory draws upon the critical scholarship of the strengths and limitations of theories, philosophies, and perspectives in the engagement of researchers and practitioners in the realization of the transformative potential of their research and practice (Rahmawati & Taylor, 2015). The conventional notion of theory as a framework is contested by a hermeneutic perspective of theory as referent (Tobin & Tippins, 1993). The

shift from framework to referent is indicative of the limitations of theory and practice. Likewise, transformative praxis as theory can be better described by the idea of radical fallibilism, for the nature of theoretical conceptions, categories and classifications is transient, imperfect, and subject to revisability, such as the theorems and proofs of mathematics (Ernest, 2016). Our notion of transformative praxis is premised upon the notion that change-driven initiatives are less likely to work under the guise of an absolutist vision of the world.

Theory, therefore, is not only for the purpose of describing the world, but is also about taking a stance, making a commitment to change, and engaging consciously in the lifeworld of self and others. A transformative activist stance is less about texts and ideas as Eidos, than it is about the dynamic interplay between texts and lifeworld, very much akin to dialectically reconstructing the perspective embedded in one's own research and practice (Stetsenko, 2017). Such an emergent nature of theory can be validated better by the lived experience of those who are part of the research and practice. Such a dynamic validation process, as Jack Whitehead (2009) succinctly says, is an act of developing one's own living educational theory.

Methodology

Our idea of transformative praxis as methodology is embedded in the commitment of researchers and practitioners to engage in a process of meaning-making that contributes to create socially just, empowering, and inclusive systems and practices (Luitel & Taylor, 2011). The limitations of humanistic methodologies are well documented in recent publications that call for post and multiparadigmatic designs to ensure both rationalistic and postrationalistic approaches become systemic (Andrew, 2017). This systematicity is informed by the dialectics of givens and emergent, such as evidences and meanings, pre-specified protocols and nascent relations, observers and actors, and prescriptive and negotiated standards. The core of this dialectics is the desire to use a jazz metaphor in creating an empowering (i.e., inclusive, equitable, and participative) environment for most, if not all, to contribute to generating meanings and models (Denzin et al., 2017). Thus, researchers and practitioners engage in new language games that ensure the capturing of evidences that are only limitedly accounted for through processes grounded in the hypothetico-deductive system. For example, the exclusive use of the language of data might not help to capture the voices of the field of engagements by researchers and practitioners. The idea of research subjects and informants presents a very limited view of others whom researchers and practitioners engage with in making sense of the lifeworld. Instead, our view of transformative praxis as methodology considers others as collaborators, participants, and actors in contributing to our individual and collective sensemaking of the lifeworld. An exclusively rationalistic approach to sensemaking through analytical and deductive methods is insufficient for capturing dynamic realities informed by the interplay of data and voices, senses and emotions, descriptions and visions, perceptions and feelings, analytical and ethical, and minds and bodies, to name but a few (Denzin, 2019). Doubting the Enlightenment ideal that humans (with their rational faculties) are the only species capable of generating knowledge, this posthumanist shift enables researchers and practitioners to become mindful of ecologies that can contribute to the process of making sense of the world (Cudworth & Hobden, 2017).

Professional Development

Given the reflexive engagement of researchers and practitioners in the lifeworld, we hold the view that transformative praxis contributes to the professional development of researchers

and practitioners through critical reflection on both self and other's values, beliefs and practices. Practitioners can use different forms of reflection, such as retrospective, ongoing, and anticipatory (Johns, 2017). Retrospective reflection refers to reflection on events, activities and performativities accomplished in the past. The main purpose of such reflection is to examine events that have transpired from the vantage point of new possibilities. Reflection on our ongoing actions can help immediately improve, revise, and modify our activities and engagement in the world (Brookfield, 2017). Such an approach to reflection-in-action makes practitioners mindful of ongoing events and eventualities. In the same manner, anticipatory reflection enables practitioners to envision into possible opportunities and challenges embedded in their practice.

Research processes informed by critical reflexivity enable researchers to engage deeply in examining self and others' values, assumptions, beliefs, and practices. This reflexive process, for us, is further enhanced by the researcher's orientation of research as/for learning in which the subject of learning becomes how the researcher's convictions, actions, and positionality contribute to imagining socially just, inclusionary, and equitable practices and systems. A persistent reflection on power relations between researchers and participants enables them to embody transformative sensibilities in their thinking and actions (Brookfield, 2008). In recent times the power relations between humans and the natural environment have become a subject of critical reflection, as privileging humans over other species has endangered Mother Earth.

Inclusive Genres and Logics

With the advent of the Enlightenment project, the use of linear (c.f., nonlinear), clean (c.f., messy), dualistic (c.f., dialectical), and prescriptive (c.f., perspectival) modes of thinking and representation have been commonplace in social and educational research, thereby reducing the chance of engaging researchers and practitioners in deep, embodied, and intimate voices and visions about their research and practice (Saldana, 2018). Embedded in such modes of thinking and representation is the hypothetico-deductive system that puts primacy on deductive (i.e., based on linear certainty through pre-existing premises), analytical (i.e., based on the dualism of right and wrong), and propositional (i.e., based on prescriptive causation) logics and genres (Luitel & Taylor, 2013). These exclusionary logics and genres promote a technical rationality that offers only a limited opportunity to exercise, embody and showcase much-needed praxis in researchers' and practitioners' engagements for empowering, just, and equitable systems and practices (Taylor & Luitel, 2019).

The void created by the Enlightenment project in exercising, embodying, and portraying transformative praxis can be filled by a combination of conventional and inclusionary logics and genres, including metaphorical, dialectical, poetic, and narrative. Metaphors are used to unpack conceptual complexity and subtlety embedded in the lifeworld, conceptual systems, and structures. Oftentimes, metaphors are mistakenly taken as a rhetorical device rather than our embodied conceptual systems that are connected through an allegorical, analogical, proverbial, mythical, and ecological system of thought. Various forms of dialectics (e.g., here and there, up and down, past and present, theory and practice) are constitutive of social realities, although they have been mistakenly used as binary opposites in the conventional use of logic and genre. Dialectical logic imagines realities resulting from a dynamic interplay between so-called opposing categories as, for example, theory cannot be conceived without practice and *vice-versa* (Taylor, 2013).

Poetic logics and genres are used to represent nonlinearity, ineffability and subtlety embedded in the praxis of researchers and practitioners as change agents (Faulkner, 2007). The undue privilege of linearity in thinking and representation has been an obstacle to

unpacking the messiness of our lifeworld. Likewise, the standard academic language of the plain, cut-and-dried, and impersonal genre does not enable researchers and practitioners to represent that which cannot be expressed. Poetic logics and genres are useful for researchers and practitioners to bring forth the subtilities of power, privilege and hegemony (Faulkner, 2016). Narrative logics and genres are used to bring forth contextual accounts arising from our actions (and inactions) in the lifeworld. Such accounts can be categorised as resistant, healing, and advocacy. Resistant narratives develop an oppositional stance as a recourse for creating narrative visions of enabling societies. Narratives that heal people in difficulties can be cathartic for those who have gone through sufferings of different kinds. Likewise, narrative logics and genres are also used to envision an inclusive, equitable, and empowering social systems and practices (Sjollema & Bilotta, 2017).

Empowerment

Transformative praxis as empowerment draws on the ongoing discourse of the emancipatory interest that emphasises autonomy, responsibility and criticality (Kincheloe & Pinar, 1991). The notion of autonomy is conceptualised as an outcome of the process of the critical reflective ability of practitioners, researchers, and people in their relations with colleagues and participants. The process of reflecting on self is not only cognitive but also an act of turning ego onto itself, very much akin to the convictional and actional form of engagements (Maseko, 2018). In this way, the chance of an individual acting on whim and habituated compulsion is greatly lessened. Responsibility is connected with the process of becoming an autonomous agent who takes charge of what he or she has committed to. Here, commitment refers to one's willingness and readiness to act as a change agent in the context of research and practice. However, there might be dangers associated with change agents embracing a paternalistic approach to dealing with participants and actors. The cure can be found in maintaining a well-developed criticality embedded in the process and outcomes of research and practice. Disciplines, structures and models are critiqued for their limitedness in harnessing justice, equity, and empowerment. In this way, empowerment becomes a multi-dimensional social process that helps gain control over our practices by questioning taken-for-granted assumptions and frames of reference, and generating more empowering beliefs and informed actions (Luitel & Taylor, 2011). Transformative praxis enables practitioners and researchers to act as change agents who raise the consciousness of the self and others through acts of critical reflection.

The Inaugural Issue

This inaugural issue of the Journal includes four original articles that make cases for socially and cosmologically responsible educational processes, positive deviance as/for insubordination in the educational process, holistic orientation for transformative learning, critical reflection as research, and self-culture dialectics as/for raising consciousness.

Varghese envisages how teaching and learning processes need to be connected with the cosmos while teaching and learning mathematics. Subscribing to critical autoethnography, the discussion focuses on why and how mathematics teaching and learning needs to take into consideration our relationship and responsibility towards the natural environment and the cosmos as a means for making educational processes cosmologically responsible. Taking his lived experiences as 'data' and reflective meaning-making as 'analysis', Varghese looks into his life as a student in school and university days, as a Jesuit, as a teacher and as a student, thereby reflecting the shortfalls of culturally and cosmologically decontextualised educational processes. Likewise, he reflects on his relationship with the

cosmos, which challenges a materialistic educational system that lacks responsibility towards the environment and cosmos. The author promotes his vision of establishing connections between curricular topics and cosmological issues to raise awareness in students for caring for the cosmos.

Orey and Rosa discuss the concept of positive deviance concerning the research program of ethnomathematics. Ethnomathematics as a pedagogical action helps students to overcome the use of disassociated techniques that are often blindly memorised. They discuss the notion of positive deviance as a means for pedagogical actions that deal with content often disconnected from the reality of the students. They highlight the importance of analysing the relation between culture and mathematics by questioning the predominant view of mainstream mathematics as culture-neutral and diversifying teaching strategies. Their discussion of 'insubordination' triggered by ethnomathematics enables practitioners and researchers to adopt positive deviance in developing pedagogical actions to connect mathematics with reality. They conclude that positive deviance can be considered as combat against the dehumanizing effects of curricular and bureaucratic subordination. Ethnomathematics can allow practitioners and researchers to develop innovative pedagogies that help students to unpack their sociocultural and academic potential, through a diversity of teaching strategies used in the mathematics curriculum.

Ojha makes a case for holistic orientation by discussing concepts associated with transformative learning, including reflective practice as a means for developing educators' perceptions of holistic education. Further, he argues that educators with holistic orientations emphasise inner lives, balance, interconnections, trustful and authentic relationships, dialogue, and concern and care for others in their pedagogical practices. Ojha's descriptive insights into pedagogical reflections of teachers exemplify holistic orientations as a potentially practical strategy for transformative learning. The article concludes with the note that the role of an educator is to explore their own essences by acquainting practitioners with various paths and possibilities. Teachers as practitioners are encouraged to recreate holistic learning contexts that potentially promote transformative learning.

Luitel charts his transformative research journey by reflecting on his experiences of the process of learning and teaching in mathematics. Guided by autoethnography as methodology, Luitel's reflections are useful for other researchers and practitioners wishing to reflect on the strengths and limitations of learning and teaching activities in their contexts, thereby envisioning more inclusive practices for the future. Subscribing to critical self-reflection on his professional praxis as a teacher, researcher and educator, Luitel questions self and others in terms of how they can work to solve issues of disengagement in the mathematics curriculum, pedagogy and assessment to improve the landscape of mathematics education for social justice, inclusion and empowerment. The Habermasian knowledge constitutive interests (i.e., technical, practical, and emancipatory) and Schubert's curriculum images (i.e., content or subject matter, experiences, cultural reproduction, etc.) are theoretical referents used to interrogate the researcher's experiences of doing and learning mathematics as a mathematics teacher and practitioner-researcher.

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Suggested Citation:

Luitel, B. C., & Dahal, N. (2020). Conceptualising transformative praxis. *Journal of Transformative Praxis, 1*(1), 1-8.

Open Access

Journal of Transformative Praxis

Vol. 1, No. 1, 2020, pp. 9-24
DOI: https://doi.org/10.3126/jrtp.v1i1.31757

Received: 31 March 2020; Revised: 12 May 2020; Accepted: 12 June 2020

Original Article

Connecting Mathematics Education to my Relationship with the Cosmos

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Abstract

I believe that human beings are closely interconnected to the cosmos in which we exist. Today, we hear a lot about caring for the Mother Earth. More and more humans are coming to realize the need to protect our environment and to stop the uncontrolled exploitation of the nature. With the exploration of the space, we have also come to understand that we are only a tiny particle in this vast cosmos. As a result, we are responsible towards the cosmos that surrounds us and in which we are part of. Often mathematics teaching-learning has been limited to the cognitive level and very seldom concerns of the ecology and issues related to the cosmos are brought up in mathematics classrooms. My mathematics teaching-learning life was no exception as there was hardly any connection to my relationship with the cosmos. Through this autoethnographic study, I show how mathematics teaching-learning needs to and can take into consideration the important relationship and responsibility we have towards the environment, universe and the cosmos and how we can teach pro-cosmological behaviours to our students through topics in mathematics they are learning. This will be done by narrating my lived experiences of missing the link with the cosmos in my mathematics classrooms both as a student and a teacher and by presenting a few examples of making mathematics teaching-learning cosmologically responsible in classrooms.

Keywords: *Relationship. Cosmologically responsible. Pro-cosmological behaviours. Connecting and Caring.*

Introduction

This article is a section of my MPhil thesis about *relationship responsible* mathematics in which I inquired about the connection of mathematics teaching-learning to my relationship with the cosmos, others, Transcendental, and the self. In this article, I take up the connection of mathematics teaching-learning to my relationship with the Cosmos. This is an autoethnographic inquiry in which I look at my life as a student of mathematics in school and

ISSN: 2717-5081 (Print); 2738-9529 (Online)

university days, as a Jesuit, as a mathematics teacher, and finally as an MPhil student of Mathematics Education. While doing so, I bring in narratives that are related to the topic under study from my teaching-learning experiences of mathematics during the above stages.

Setting the Background

Today, the care of Mother Earth is a major concern. More and more human beings are coming to realize the need to protect the environment and stop the uncontrolled exploitation of nature. Climate change, ozone layer depletion, extinction of many species, melting of the glaciers and the arctic zone are all much talked about these days. There is a sudden surge in talking about the impact of human behaviour on the planet and the responsibility of human beings in taking care of it. For example, in a recent interview, Stephen Hawking, the noted cosmologist and physicist, claimed that human beings have only 100 years to colonize another planet against his earlier time limit of 1000 years. According to him Planet Earth is heading for doom due to climate change, over-population and possible asteroid strikes (Holley, 2017).

With the exploration of space, we have also come to understand that we are only a tiny particle in this vast cosmos. As Stephen Hawking said once, "In less than a hundred years, we have found a new way to think of ourselves. From sitting at the centre of the universe, we now find ourselves orbiting an average-sized sun, which is just one of millions of stars in our own Milky Way galaxy" (Hawking, n.d.). Carl Sagan, another noted cosmologist, also emphasized this cosmic nature of ours through his writing and shows. These scholars invite us to become cosmic in our thinking, attitudes, and behaviour.

Similarly, many spiritual writers talk about our cosmic nature and our deep connection to the cosmos instead of the immediate environment and Planet Earth (Krishnanada, n.d.; Painadath, 2009; Pope Francis, 2013; Tolle, 2003). I see a greater interconnectedness with Planet Earth, the living and nonliving beings, the solar system, the stars, the galaxies, and everything that exists in the universe. Riley-Taylor (2002) suggests that education should teach students to be aware about their place in the cosmological order and the need for them to be cosmological in their views. Further, I also believe that our space explorations, nuclear programs, air travels, radar technology and missile programs will eventually have unforeseen negative impacts, not just on our planet but on the cosmos as a whole.

Consequently, I would like to use the term cosmological, instead of the usual terms like ecological and environmental, since it encompasses everything that is part of the universe. We should not limit our connection just to Planet Earth alone but must extend it to the whole universe. Further, our relationship with the cosmos must encompass everything that is part of it. The present crisis that threatens the cosmos is due to the inappropriate relationship of human beings with nature (Lieflander et al., 2013). The existence of future generations hinges on how our relationship with the cosmos is understood and lived in the present. Thus, developing the right type of relationship with the cosmos is indispensable and the need of the hour.

Mathematics being a major player in the development of technology bears a huge responsibility in developing this right relationship. The International Commission on Mathematical Instruction in 2011 talked about how mathematics has been part of almost everything that happens around us. However, very seldom mathematics teaching-learning is directly associated with such a relationship. Mathematics teaching-learning has been mostly academic and intellectual focusing on learning the steps, memorizing the formulas and processes and reproducing them during exams to score marks. It has suffered from a 'disconnect and alienation' between what is taught and the life of the students and teachers

alike. There is no surprise then that relationship with the cosmos was not one of the priorities of mathematics teaching-learning.

As I reflected over my relationship with the cosmos, many questions began to emerge. Why was the concern for Mother Earth and the cosmos never a part of my teaching-learning of mathematics? Now that I realize the need for it, how can I promote the right relationship with the cosmos in my mathematics classroom? How can I teach pro-environmental behaviours through mathematics? (Kollmuss & Agyeman, 2002). How can the teaching-learning of mathematics enable students and teachers to become persons who understand their place in the vast cosmos and who are responsible for caring for the cosmos? How can mathematics help students and teachers to develop the right type of relationship with the cosmos? In other words, how can mathematics become cosmologically responsible?

Methodological Journey

I wanted my research to be a reflective journey to find answers to the above questions and thus discover the importance of connecting mathematics teaching-learning to my relationship with the cosmos. This article is then an autoethnographic inquiry through which I enter into a personal, retrospective and introspective journey of my life as a mathematics student and teacher. In this reflective, critical and personal voyage, I explore my teaching-learning of mathematics in relation to my relationship with the cosmos. I have attempted in this autoethnography to detail, explain and make meaning of my experiences as a mathematics teacher and learner in connection with my relationship with the cosmos. I am both the researcher and the primary participant of this study. The primary source of data for this study is my lived experiences of mathematics teaching-learning in the context of my relationship with the cosmos.

I have involved a relativist ontology based on multiple and contextual realities personally constructed through my experiences as a school student, as a university student, as a Jesuit, as a teacher and as an MPhil student besides through the lenses of my students and teachers. The epistemological approach that I have taken in my study is critical subjectivity. The nature and form of the knowledge that is explored in my study is subjective, based on my lived experiences and derived from critical reflection on those experiences. By critically looking at my experiences I have been able to derive new meaning and knowledge (Mezirow, 1997, 2003). The primary value that has guided me in this study is transformation; transformation of myself into a better teacher and my students into better human beings which will eventually lead to wider transformation in society, especially in the way we relate to the cosmos.

Being a transformative research that embodies research as learning, there are elements of many paradigms in my study. I have been an interpretive researcher in the way I have looked at how mathematics teaching-learning was connected to my relationship with the cosmos. I have applied critical paradigm to help me develop critical self-awareness and critical understanding of my experiences of mathematics teaching-learning in relation to the way I engaged with the cosmos. I have applied the postmodern paradigmatic approach in telling my experiences using various genres of narratives, stories, poems, anecdotes, metaphors and imageries, to make what I wrote more "realistic, plausible or believable and thus engage the readers in critically reflecting on their own experiences" (Taylor & Medina, 2011, pp. 10 -11). To ensure honesty and integrity of my inquiry, I have attempted to use quality standards like verisimilitude as lifelikeness, transferability as viability, pedagogical thoughtfulness, incisiveness as a focus and critical reflectivity as transformative process (Luitel, 2012). These standards have enabled me to create a comprehensive account of my experiences assuring fairness, authenticity and meaningfulness.

The Bagmati Connection

The foul draft from the Bagmati River made me breathe sparingly. I was on my bicycle as usual along the river corridor. I wanted to avoid the heavy traffic on the main roads. As I was pedalling, I looked into the river to see the blackish water of this holy river. I have heard a lot of people talking about how it was in the past. Every Saturday, I have also read about the Bagmati cleaning campaign which has gone beyond a year as of now.

Earlier in the year, during the monsoon too, I had cycled by the river on many occasions. Water in the river was not blackish. It was muddy but not blackish and there was no foul smell. Rather it had a pleasant monsoon smell. The river was swollen, the water level was very high and current very strong. I could not find many traces of the sewer that it used to be. Not only the colour but the smell of the water was entirely different.

I wondered what happened to this river. It pained me because there is a river that is very close to my heart. It takes me to my childhood days in Kerala, India. It is there that I first discover the alienation of mathematics from my relationship with the cosmos.

On the Lap of Nature: My Childhood

My childhood was always connected to nature. I can claim that I grew up in the lap of nature for all practical purposes. My house was in the middle of a small property surrounded by trees and plants. There were rubber trees, coconut trees, jackfruit trees, nutmeg trees, banana trees, fruit trees and many other trees one can find only in Kerala. At a very young age I learned to climb trees and enjoyed doing it whether for fun or for plucking fruits, coconuts or nutmegs. We always had cows, goats, chickens and ducks at our home, sometimes cats and dogs too. Taking care of them was a major responsibility for us children. It was as important as our studies. As a result, there was constant and close interaction with nature during my childhood onwards and my life was so connected to it and I can't imagine a life without it those days.

I was also blessed to live next to a river and my life was very much connected to it. The river lies to the eastern border of our property, hardly 25 meters away. If I stepped out of our property I would end up in the river. The river always had plenty of water since its origin was from the famous Idukki dam and the hydropower project which is the main source of electricity in Kerala. The water was very clean and serene during the dry season but would swell up during the monsoon. The water level would rise all the way up to our house during those seasons, inundating a lot of land and roads upstream and downstream. One of the things I have always wondered was about the volume of water needed to fill the river so much, inundating the bank and nearby areas. Another mathematical calculation I used to do was to count the number of steps already covered and would be able to figure out the fields of our neighbourhood where water had already entered. During the flood season, one of the first things that I did was to go to the river and figure out the level of water that arose or decreased looking at the steps and the marks that remained.

During the holidays, I spent a longer time in the river swimming and playing various games along with my friends. Diving was an important part of these games and a lot of mathematics was involved. If I did not place my body at the proper angle at the time of impact, I used to get hurt especially in the chest. Where the water was shallow, I needed to ensure that I shifted the motion of the body at the right time so that I did not hit the riverbed. Yet another fun activity we friends used to have was in finding out who could move under water the farthest. We did this by propelling our body using our toes.

There was a canoe service to take people across the river. I learned how to row it by the time I was in class five, like my brothers. Using the canoe successfully involved plenty of mathematics. Depending on the level of water, the current of the river, the type of canoe and the load in the canoe, one had to calculate how much force is applied on the bamboo stick or the paddle and how far up one had to go before changing direction to the other bank.

Another very important relationship I had with the river was through fish. The river had plenty of fish and we went for fishing daily except during the flood season. As I look back, I see how mathematics was involved in the catching of the fish. The *ottaal* (bamboo trap) that we used for fishing had a perfect circular narrow opening at the top and a much wider one at the bottom. Depending on the type of water, it had to be placed with great precision and timing to trap fish. In still water it was relatively easier, whereas in the flowing water the task became more difficult depending on the current and the movement of the fish.

My life thus was so closely linked to nature, living in a place that could boast of incomparable natural beauty and splendor. Environmental connection was experienced at every moment of my life and many of these connections had mathematics involved in them even though I was not aware of it. Even though I lived very close to nature, I am not sure if I was ever aware about the importance of caring for the environment and nature during my school days. In fact, I do not remember anyone talking about the importance of caring for nature during those days, whether in the school or elsewhere. Some of the practices we had actually went against caring for nature. For example, with friends we used dynamite blasting for catching fish which killed all types of fish, big or small, and any other aquatic life present in the area concerned. The river was the easiest place to throw things that we did not need, hoping that the river would take them eventually to the sea, without knowing how it would affect the river and the people downstream.

My school did not impart much in terms of caring for the environment. Kerala being one of the most naturally blessed places in India, environment was probably taken for granted then. We did not have any subject which directly dealt with environmental issues. We studied general subjects like mathematics, science, social sciences and three languages. It is no surprise then that mathematics had nothing to do with caring for the environment. It was 'pure' mathematics and nothing else. Even my use of mathematics in daily life was more spontaneous than what I learned in the classes. Plenty of mathematical concepts were involved while counting coconuts, and for transactions, while riding the canoe, while swimming across, diving and fishing. I learned very little of these calculations from my mathematics classes. More unfortunately, there was never any mention of caring for the nature in my classes. However, I learned many valuable lessons on it from my elders and experiences. I remember one such incident which taught me lessons that are paramount in my present life.

School of Life versus School of Mathematics

The year was 1988. I was in class eleven. We had recently renovated our house. The work was complete and things were going smoothly for a few months till we encountered a problem. My mother brought it to our notice, "The waste water from the kitchen is getting collected in the yard and it is beginning to stink. We need to do something about it." We had expected the water to be absorbed into the soil in the yard and the land nearby. But, over time, it had started spreading out instead of going down. We needed a solution. The more educated persons in the family, my two elder brothers and I, looked for a solution.

Being the most intelligent in terms of marks, I suggested, "Why not send the dirty water to the river?" Others too thought it was a wonderful idea. I was in the mathematics stream of class 11. So, I took the initiative in finding out the length and the radius of the pipe

needed in implementing the solution and the slope needed to ensure that the water flowed smoothly. All we needed now was the permission and money needed. When our father came back from work, we told him our brilliant idea.

"No, that is not a brilliant idea! It will dirty the river, degrade the water and affect people downstream" he told us.

I disagreed, "But our wastewater is very little in comparison to the water that is in the river. Besides, the current is strong, and will flush away everything. Nobody is really going to notice." My mathematics brain started retorting by presenting the logic behind our brilliant idea.

My father countered us, "Imagine if everyone living near the river did the same. If the waste water from the households of Thodupuzha (i.e., a town upstream) was sent to the river? Do you think you will feel comfortable enough to drink it or even take a bath in it? Is it not the same for the others downstream? Think about all the fish that we get to eat. Do you think they will have any chance in wastewater?" I don't think any of us really comprehended what he was trying to say, or the serious consequences of our brilliant idea. All we could think about was a solution to our problem.

"So, what else can do we do then?" one among us must have asked. "Let us try something else." He gave his idea. He told us to dig a pit of a particular size. We filled it with rocks and gravel and connected the kitchen wastewater outlet to this soak pit. I still used my mathematics to get the pit of the right size, this time for a good cause. Surprisingly this pit still serves us even after 30 years and for a new house too.

My father was only a class six educated mechanic. In those days, we hardly heard anything about environmental degradation or sustainable development in our area. Yet he knew well the results of our actions on the ecology. Life taught him which schools and mathematics lessons did not teach me or my brothers.

When I reflect over that incident now, I see the wisdom of my father. I realized that if we knew wastewater and sewage were mixed in the water, we would not have been comfortable in entering into the river as we used to. Our relationship with the river would have been different in many ways, like it is with the Bagmati River now. We would not have liked to take a bath or swim in such a river. All the water that I drank during my swimming expeditions and all those tasty fish that I caught would have resulted in a different story altogether. Even now, when I visit my parents, one of the first things that I do is to go for a swim in the river no matter how late into the night it is. The water level is neither as high as it used to be nor is the water as clean as it was in my school days. Yet, I cannot disconnect from that river so easily.

So Near Yet So Far

My relation to the cosmos is one of the four relationships (With God, others, nature and oneself) that define me as an integral human being (Pope Francis, 2013). However, this component was never part of my mathematics classes. I consider my school days as a perfect example of how alienated my mathematics learning was from cosmological concerns in general and environmental concerns in particular. As narrated in the above stories, my mathematics classes were devoid of any references to my relationship to the cosmos. On the one hand, I was living a life very close to nature outside the classroom, but had no connection to it inside the class, on the other hand. There was this dichotomy that I experienced during my school days. My classes never indicated anything about how I was a tiny speck in the vast universe, how I was closely related to the other living and non-living beings in the universe. My classes were focused merely on cognitive activities. Further my mathematics classes failed to teach me about my responsibility towards caring for the cosmos. I did not

learn from my mathematics classes which of my behaviours were harmful to the cosmos. Neither did I learn to develop pro-cosmological behaviours (e.g. saving water and electricity, avoiding plastics and using reusable things, opting for public transport, proper management of waste etc.) (Kollmuss & Agyeman, 2002) to care for the cosmos and everything in it.

Schools have a major role to play in instilling pro-cosmological behaviours in children. Coertjens et al. (2010) in their study clearly bring out this conclusion. They say "schools do have an impact on students' environmental awareness and attitudes and can, therefore, be drawn upon by Environmental Education policy makers as means of fuelling students' awareness and attitudes" (p. 242). They further suggest that schools should use activities that can kindle in students a caring and pro-environmental attitude towards the environment. It is interesting to note here that they do not mention any particular subject to be responsible for creating environmental awareness among students. They consider schools one unit responsible for it and everything that happens in schools must promote in students their role in the cosmos, their responsibility towards it. As a result, mathematics teaching-learning too must become cosmologically responsible. My learning of mathematics in my school days failed in this regard.

Another angle of looking at this is from the point of view that I lived a life very close to nature. I had direct contact with nature all the time. I lived with it, in it and of it. Nature was an integral part of me. Ideally speaking, that should have been a fertile ground for pro-environmental behaviours and attitudes, provided someone had sowed the seeds. This notion is expressed by Duerden and Witt (2010) when they say, "It appears that a combination of both indirect and direct experiences that provide opportunities for both the attainment and application of environmental knowledge and attitudes, coupled with the promotion of perceived freedom, is an effective method of promoting pro-environmental behavior" (p. 391). In my case, my direct experiences with nature and the use of mathematics in my day-to-day activities would have been strong catalysts for imbibing a genuine love for the cosmos and responsibility towards it. However, such a connection was never made in my mathematics classes. The only ones who made such a connection were probably my parents and elders, even though I did not understand it at that time.

Chawla and Cushing (2007) mention how childhood experiences are considered to be significant and formative experiences in terms of developing pro-cosmological behaviours. According to them, "nature activities in childhood and youth, as well as examples of parents, teachers and other role models who show an interest in nature, are key 'entry-level variables' that predispose people to take an interest in nature themselves and later work for its protection" (p. 4). They also emphasize the pivotal role played by teachers and education in the lives of environmental activists. Even though their study does not focus on a particular subject, the role of learning mathematics and mathematics teachers is also inherent to their theory about imparting proper cosmological behaviours among students.

My mathematics learning in school failed in yet another aspect. I missed one of the crucial elements of integral education as seen from the point of view of the Ignatian Pedagogical Paradigm (IPP). Proper application of the five components of IPP: context, experience, reflection, action, and evaluation, would have helped me to "make conscious, responsible choices" (McAvoy, 2013, p. 64) with regard to my relationship with the cosmos. Understanding my context of being close to nature, my learning and other experiences inside and outside the classroom should have led me to a deeper reflection on my responsibility towards the environment and cosmos. This in turn would have enabled me into pro-cosmological actions. Consequently, evaluation would not have been focused just on what I learned cognitively but also on what I have learned for my life in my responsibility towards the cosmos, for the present and the future. The saga of this disconnection continued even during my university studies.

University Studies: Away from the Lap of Nature

My University studies were in two of the biggest cities in India, Mumbai and Chennai. The subjects that we learned were integration, differentiation and other calculus topics, transformations, groups and subgroups, discrete mathematics, real and complex analysis, computer programming and system analysis, to name a few. We studied theorems, corollaries, lemmas and what not. We studied proofs, solutions, and applications and wrote programs in computer languages. Once again it was pure mathematics. Neither our teachers, nor we ever bothered to see how what we learned also had connections to the cosmos. No one even ever bothered to keep our classrooms clean. We did make use of the dustbins if we saw them around. Otherwise, we disposed of garbage wherever we wanted.

In Mumbai, we knew the usefulness of nature when we spent our leisure time in the woods, an area inside the compound covered by trees. There were only a countable number of trees and it was hard to find a place where there was shade. Yet it was the most popular place for us to hang out. The little natural environment we had was very highly priced. We spent a lot of time chatting under those trees, discussing everything but mathematics while we sipped a cup of coffee or cool drinks.

A trip to a village during my third year BSc illustrated how distanced some of my city friends were from nature. Many of them were surprised to see for the first time a tomato or a chilli plant, a colourful rooster, an earthworm, how ugly/beautiful a caterpillar looked, how the air smelled different, how pleasant it was to hear the singing of the birds in the morning and how different the water tasted. I and a few others who had made these discoveries in childhood went around teasing them and boasting about our wonderful childhood. Apparently, this was the first time many of them had stepped out of the city and for the first time to a village. They were used to the concrete jungle of the city where connection to nature was minimal. Probably they had very little in terms of environmental education.

My masters' study life was a bit different. The college campus where I did my M. Sc. spanned about 100 acres in the city of Chennai. Anyone who has been to Chennai knows that the city has only three seasons: 'hot, hotter, and hottest!" So, the presence of every tree was precious, and we had many of them. Further, we suffered from acute water shortages very often in the campus. As a result, saving water was a concern and we were reminded about it every now and then in the hostel. Once again, the topics that I studied in the class never had much to do with cosmological concerns. I studied pure advanced mathematics and computer programming. Whatever connection I felt with nature was due to the weather and the necessity of saving water.

There was an aura of pride when I said I was doing BSc or MSc in pure mathematics. But I failed to learn that

> there are mathematical modelling and algorithms behind water resource management and hydrological forecasting; behind energy generation, preservation and allocation; behind weather prediction, fluid dynamics, forecasting extreme events (tsunamis, hurricanes, earthquakes) and risk management; behind analysing complex systems (like transportation and finance); behind understanding epidemic spread and virus infections; and behind ecological conservation (ICMI News 16: February 2011 as cited in Gellert, 2011, p. 20).

I consider adulthood as the time when one begins to make informed and conscious choices with regard to life. Since much of one's adulthood is spent in college studies, I believe what we learn in college guides our decision-making. When it comes to choices regarding environmental concerns, the college years would have been an important time in helping in this decision-making process. The critical role of higher education in caring for the

environment is stressed by many researchers when they talk about sustainable education. Cortese (2003) says, "Higher education institutions bear a profound, moral responsibility to increase the awareness, knowledge, skills, and values needed to create a just and sustainable future" (p. 17). The author further mentions that higher education should take the leadership role in this sustainable education like it did for space and the arms race and other technological and medical advances. While criticizing the compartmentalization and disconnected specialization that is found in higher education, Cortese recommends an interdisciplinary thinking in the content and context of education, to enable students to see them as an integral part of nature and the responsibility towards caring for it.

Shephard (2008) claims that "the central element of education for sustainability is a quest for affective learning outcomes of values, attitudes and behaviours" (p. 95). He goes on to say that higher education must take into consideration this affective domain in order to achieve sustainable education. Besides suggesting interdisciplinary approaches, he also advocates that environmental themes be developed in subjects that are not directly related to environmental concerns. This would mean that mathematics should also involve such environmental themes. However, my university mathematics education did not include such themes in classrooms. Further, I can say that my university education failed to challenge many common assumptions like the following:

- Humans are the dominant species and separate from the rest of nature.
- Resources are free and inexhaustible.
- Earth's ecosystems can assimilate all human impacts.
- Technology will solve most of society's problems.
- All human needs and wants can be met through material means.
- Individual success is independent of the health and well-being of communities, cultures, and the life support system (Cortese, 2003, p. 17).

Jablonka (2003) considers environmental education an aim rather than a subject and, as a result, part of every subject. She recommends a new way of teaching-learning mathematics and calls it mathematical literacy. She says, "Mathematical Literacy for Environmental Awareness considers the possibilities of linking mathematical literacy not only to an individual's capacity to solve personal and local problems, but also to global environmental concerns" (p. 76). She goes on to add that the role of mathematics in the development of destructive technologies and its dehumanizing effect is often not taken into consideration. She believes that mathematical literacy would create a human view of mathematics and thus teaching-learning of mathematics would become more environmentally responsible. When I look back, I realize that my undergraduate and postgraduate studies of mathematics were not able to promote mathematical literacy in me. From them I did not imbibe the responsibility of mathematics teaching-leaning towards caring for the cosmos.

The Awakening: Jesuit Life

Probably the first time caring for nature became part of my life was when I began my life as a Jesuit. The core of the Ignatian Spirituality that I was taught to develop is to 'find God in all things" because "God dwells in creatures giving them existence and God labours and works for me in all the creatures" (Loyola, 1993, p. 95). Similarly, the purpose of creation and everything else around us is to help us to "praise, reverence and serve God" for which human beings are created (p. 23).

From the very beginning of my training, I learned from one of my directors the importance of caring for nature. We planted trees, took care of them, watered them, protected them. When I went back after 25 years to the place where I had my initial training, I saw how

the trees we planted had grown. I was happy to know that the level of water in the water source has gone up and many villagers also make use of it these days.

While doing my studies in Philosophy, the importance of caring for nature was better established. There I learned how every act of ours has an impact on nature. In the course on cosmology, science and religion, I learned the fact that we are only a minute part of this vast universe. Even though human beings are small particles, collectively we have caused so much damage to the universe.

I began to see the cosmic nature of my existence. When I learned about how Copernicus, Galileo, Clavius, Kepler, Carl Sagan and Stephen Hawking saw the universe, I realized not only my insignificance in the universe but also my responsibility towards it. I began to see the creation story of the Bible differently and understood its supposed meaning.

Caring for nature became a responsibility and not an option during my theological studies when the notion of sin was explained to us in our Moral Theology classes. While learning about sin, alienation from nature was one of the four manifestations of sin. This alienation takes place in many ways when I do not have the right relationship with creation. When I consider myself the master of creation instead of a part, I am alienated from creation. When I look at creation as a thing to be exploited for my selfish benefits, I am alienated from nature. When I destroy creation in the name of development, I am alienated from it. When I do not take care of it and do not do my bit in caring for the environment, I am alienated from it. Not having the right relationship with the cosmos meant that I was committing a sin. I learned that the Earth is something that is very special to God and He wants us to take care of it. "It is thus that God loves His Earth, enables it, enriches it, and makes it beautiful and fecund. And He places it in our hands so that we too may join Him in caring for it, may till it, keep it, humanize it, make it our home and our extended bodily self" (Rayan & Kunnumpuram, 2013, p. 106).

During the General Congregation 35 of the Society of Jesus in 2008, the whole Society and its collaborators were called to establish a triptych of relationships with God, with others and creation. One of the three relationships was the right relationship with creation which encompasses the whole cosmos. The document invites, "Jesuits and those who share our mission to show ever more effective ecological solidarity in our spiritual, communal, and apostolic lives. This invitation calls us to move beyond doubts and indifference to take responsibility for our home, the earth" (JCSA, 2008, p. 79).

Subsequently, caring for creation thus became a commandment in our lives. We were urged to believe in the God of the cosmos and to become reconciled to it in establishing the right relationship with it. In order to achieve this reconciliation, we are called to a *metanoia*, a change of heart, and "to become agents of change ourselves. From the goodness of nature and the ethical vision of right relations we gain the spiritual energy to live lives of reconciliation between God, his creatures and ourselves" (Alvarez, 2010, p. 27)

I too was moved by such a clarion call and wanted to repair my relationship with creation. I began to practice a lot of pro-environmental activities. The three Rs -- Reduce, Reuse and Recycle -- became a mantra in my life in many ways. I saved water whenever I could. I reduced the use of paper or recycled it as much as possible. I used the dustbins and avoided littering. I avoided mineral water and carbonated drinks after hearing about the impact of their production on ground water. I turned off lights whenever I did not need them. I took part in tree plantations, took care of gardens and so on. Caring for the cosmos had become part of my life now but only as part of my mundane daily life. I did not do anything outside it. I was practicing environmentalism only in my private sphere and I never bothered to extend it to the public sphere (Chawla & Cushing, 2007). It was mostly a spiritual awareness and practiced as a Jesuit than as a mathematics teacher-learner. Further, it never

occurred to me in the initial years of my teaching days that my teaching-learning of mathematics had any connection to it.

The Teaching Journey – from Total Alienation to Coming Closer

My first teaching assignment was teaching mathematics in classes five and six. My initial energy was spent on establishing myself as a good 'mathematics' teacher. This meant that I taught mathematical concepts well, explained them clearly, ensured that students had enough practice and they did well in the examinations. Students had to be totally under my control; pin-drop silence was demanded when I spoke and absolutely no fooling around.

One of the first things that I did and do even now after I enter a class is to ask the students to pick any paper or type of garbage thrown on the floor. I could not bear a dirty floor or classroom and wanted the students to keep the classroom clean. Once the classroom was clean, I shifted into a different planet. The planet was my mathematics teaching-learning. There we were mathematical aliens who ate, drank, slept, and dreamt only mathematics. The students did it and the teacher facilitated it. Anything else was from a different planet and we would not entertain it. Caring for the environment was one of such aliens which I never wanted to visit my classrooms during the initial years of my teaching.

One fine day as I walked into the class, I saw a pool of blue ink on the floor. There was no way I was going to start the class with something of that sort on the floor.

I asked the class angrily, "Who is responsible for this?" When I realized that nobody would want to answer that, I changed my mode.

"Who would like to be responsible for cleaning it?" A boy and a girl from the back raised their hands first. Both were simple average students in mathematics. The so-called excellent students in mathematics did not want to take the responsibility for cleaning it. In fact, I came to know later that it was one of those excellent students who had knocked over the ink bottle accidently. That student was not taking responsibility for cleaning, either. When it came to cleaning, it was the average students who were proactive as if they had a better concern for the environment.

In the schools I was involved with, I supported and appreciated the efforts of the Eco Clubs and the Environment Clubs in promoting the care of the environment. As the principal, I ensured that the World Environment Day was celebrated on a mega scale by the whole school. There were cleaning campaigns, awareness programs, planting trees and what not on that day. Everyone in the school would be involved in one activity or another to mark the occasion. It never occurred to me that I should have used my mathematics classroom also for such activities not just on special occasions but daily. I kept such lessons for other subjects like Environmental Education.

While travelling through the city of Kathmandu and passing by the Bagmati River, I close my nose and complain about the insensitivity of the citizens of Kathmandu. During my mathematics teaching, I have made fun of the present situation of the Bagmati River and commented on the pathetic condition of the river. Should I not have connected what I taught to the preservation of the river? As a teacher, I should have been able to use my lessons in bringing awareness to the students about caring for the river instead of making fun of it. "What educators *can* influence are students' opportunities to gain knowledge, form positive attitudes about the environment, and practice action skills" (Chawla & Cushing, 2007, p. 4). I missed such opportunities in my initial days of teaching.

Slowly I began to relate mathematics topics to students' lives. Initially, my attempts were to connect each topic in mathematics to at least one human value. As days went by, I began to experiment and explore more. Once I realized the intensity of the environmental and ecological crisis, I began to think how my mathematics lessons could be connected to

environmental issues. In the process, I too began to discover the 'disconnect' that Renert (2011) talks about. He says, "As a mathematics teacher and researcher, I am experiencing a growing disconnect between the preoccupations of my professional life and the increasingly loud calls around me to attend to the problems of ecological sustainability." I realized that, like him, I too was "busy with metaphors of multiplication than to contemplate imminent environmental catastrophe" (p. 20).

I also read about the International Mathematical Union declaring 2013 as The Year of Mathematics of Planet Earth. It was a clarion call for all mathematicians and mathematical societies to wake up to the responsibility of mathematics towards the cosmos. The Union brought out four strategies to ensure that mathematics does not remain alienated from the concerns of Planet Earth. One of the four strategies was "Encourage mathematics teachers at all levels to communicate issues related to our Planet Earth through their instruction and their curriculum development" (Rousseau, 2012. p. 38). It was becoming clearer to the mathematical world that they could not distance mathematics from the environmental and ecological concerns any more. In fact, more than other subjects, mathematics had a major role in the present crisis. It was time for me to make my mathematics lessons cosmologically responsible.

The following are some ways I have attempted to connect mathematics teaching-learning to cosmological issues. I have tried some of them in my classes while others are still in the developing stages. Since I taught mostly in class ten, these lessons relate to topics in class ten.

While teaching the chapter on volume, I could talk about how a dripping tap wastes a huge volume of water. Students could be forming the habit of closing the taps properly and the value of saving water.

While teaching algebra, I could talk about the co-existence of living and non-living things, human beings and other living beings, referring to them as the number parts and the letter parts. The various operations could symbolize relationships between them.

While teaching height and distance, I could talk about how the terrace cultivation in the villages helps prevent landslides and promote agriculture.

I could also talk about missile and rocket technology, space exploration in a trigonometry class and show them how they have an impact on the environment.

While teaching lessons on mensuration, I could talk about saving paper by making use of every part of the paper properly. This could avoid wasting paper and thus save trees. When I tried this in my classes, many students began to make rough copies from the unused pages of old copies after hearing about saving paper.

I could bring in the concept of carbon footprint while teaching area and teach them how they can reduce their carbon footprint. Graphs and diagrams could be used to show various impacts of human behavior on environment by using appropriate examples.

Profit and loss lessons could be a means to impart knowledge about the harmful effects of pesticides and insecticides used by farmers to improve production and thereby profit.

The Missing Link Found: MPhil Days

When I joined the MPhil studies, I was not sure what was in store for me. I had come from a *pure* mathematics background. As the classes began, I realized that being pure only was a bad thing to happen; rather it should have been *im/pure* (Luitel, 2013). This meant that pure mathematical concepts had to be supplemented and complemented with real life situations and connections to make mathematical teaching-learning more meaningful. There were two courses that particularly challenged my experiences and assumptions of the teaching-learning

of mathematics. The first one was the course on Dimensions in Mathematics Education. Here I discovered a number of issues that were limiting my own teaching practices.

The first issue that I discovered was the compartmentalization of subjects. There seems to be a watertight compartmentalization between subjects taught. Let me explain. It is often considered that environmental issues are a part only of the environmental subjects, value education is a part only of the value education or ethics classes, and civic sense is a part only of the civics classes and so on. As a result, such things are never part of mathematics. The age-old belief that mathematic is pure and the queen of sciences renders it an unwarranted superiority (Luitel & Taylor, 2007). Consequently, mathematics should not be tainted with topics like equity, social justice, ecological concerns, spirituality and so on. They are the business of other subjects.

I was practicing the above policy verbatim in my teaching practices. On the one hand, I practiced pro-environmental behaviours in my life and encouraged students to do the same and, on the other hand, in my mathematics classes, I disconnected mathematics lessons from any environmental issues. So, my mathematics lessons had nothing to do with any environmental issues and failed in helping students discover the cosmological aspect of their lives. As I entered deeper into my MPhil studies, my reflections began to lead me from mere realizations to what I needed to do in the future. I recognized the urgent need to act for the future in my teaching-learning of mathematics. I needed to break the compartmentalization of mathematics from environmental education and cosmological issues.

The second course that changed my thinking was the one on curriculum. From the various metaphors for curriculum that I studied, I began to see the need to go beyond the cognitive dimension of education. In particular, I came to know that a proper curriculum must be also concerned about the environment and ecology. This notion of curriculum connected to nature and ecology was very strong in the metaphor curriculum as a garden proposed by Baptist (2002). The garden metaphor portrays the close connection that a student must have with nature not only in terms of learning, but also in applying what is learned in the classroom. Consequently, mathematics lessons also must have such connections made in the classrooms.

On the one hand, the reflective learning in my MPhil classes corroborated the little efforts that I had initiated in my classes while, on the other hand, it also raised the need to do more. It was time for me to green myself and my mathematics teaching-learning. “The greening of the self involves a moving beyond the ‘separateness, alienation, and fragmentation’ constitutive of the dichotomous self and other” (Riley-Taylor, 2002, p. 122). In order to accomplish the greening of my mathematics teaching-learning, I needed to come out of the "separateness, alienation, and fragmentation" that have been part of it since my childhood and to some extent part of its history.

Furthermore, greening myself entails a new worldview, a new cosmology wherein I do not see myself as separate from the cosmos but rather as part of it, in it and the cosmos being part of me. This new cosmological view “recognizes the dynamic interplay between all forms, human and non-human, as contributing to a process which is fundamentally based on diversity” (Riley-Taylor, 2002, p. 100). A new ecospiritual praxis must be my way of life whereby I become strongly aware about my place within the larger cosmos, my responsibility towards it and ushering in change in my attitudes and behaviour through reflection (Riley-Taylor, 2002). This is the kind of wisdom that my father, many other elders and indigenous people applied even though they did not have the kind of education that I had. I hope such an ecospiritual praxis and wisdom will enable my mathematics teaching-learning to be more cosmologically responsible.

Conclusion

As a mathematics educator, I have grown in my relationship with the cosmos. I no longer see mathematics as alienated from cosmological concerns; rather I see cosmological concerns as an integral part of my mathematics teaching-learning. As a student of mathematics, I experienced almost complete alienation of my relationship with the cosmos from the topics I learned even though I lived very close to nature and interacted mathematically with it very often. However, caring for the environment and enhancing my relationship with the cosmos were not part of my learning. As a Jesuit, my relationship with the cosmos became a spiritual endeavour while it did not affect the mathematician in me. Thanks to the Ignatian Pedagogical Paradigm and MPhil studies, the mathematics educator in me eventually has comprehended the importance of mathematics becoming cosmologically responsible.

Through the personal reflections on my experiences that I undertook during this inquiry, I have consolidated the need to green myself more and my mathematics teaching-learning as well. I want to ensure that my mathematics teaching-learning is cosmologically responsible by using my lessons to promote pro-cosmological behaviours among students. I want to establish connections between mathematical topics and the cosmological issues in order to raise awareness in students, challenge their beliefs and motivate them to action towards caring for the cosmos. I also believe that with more creativity and greater effort, teachers can make mathematics cosmologically responsible and promote pro-cosmological behaviour in students. If we can overcome our compartmental and puritanical perspective of mathematics teaching-learning, it will empower not only the teachers concerned, but also their students to relate positively with the cosmos in their lives. This will guarantee that unlike in the past, our lives become beneficial to other human beings, other living beings and the universe. In my life, the journey of making mathematics cosmologically responsible has only begun and I know there are miles to go.

Acknowledgments

I would like to thank all my Jesuit companions for being there whenever I needed any help during my inquiry. I am highly obliged to those University family who taught me to think out of the box regarding mathematics education and also for all the other assistance I received for the completion of this article.

Funding

I have not received any funding for doing this research.

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Suggested Citation:
Varghese, J. (2020). Connecting mathematics teaching-learning to my relationship with the cosmos. *Journal of Transformative Praxis, 1*(1), 9-24.

Open Access

Journal of Transformative Praxis

Vol. 1, No. 1, 2020, pp. 25-35

DOI: https://doi.org/10.3126/jrtp.v1i1.31758

Received: 2 April 2020; Revised: 2 May 2020; Accepted: 12 June 2020

Original Article

Connecting Ethnomathematics to the Concept of Positive Deviance

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Abstract

An impasse in mathematics education is related to its frequent lack of acknowledgment of local mathematical practices in its research theoretical basis. Pedagogical action of ethnomathematics aids in recording cultural-historical forms of mathematical procedures and practices developed by members of distinct cultural groups. Ethnomathematics is a form of push back from colonization without attempting to replace academic mathematics. Hence, a sense of *insubordination* triggered by ethnomathematics is *creative* and often evokes a sense of disturbance that causes a conscious review of rules and regulations endemic to many curricular and educational research contexts. This process enables educators and investigators to adopt *positive deviance* in developing pedagogical actions that deal with content usually disconnected from the reality of the students in order to deal with imposed norms and rules. Thus, positive deviance involves an intentional act of bending the rules in order to serve the greater good of the school communities.

Keywords: *Cultural groups. Ethnomathematics. Pedagogical action. Positive deviance.*

Initial Considerations

Ethnomathematics is a form of pedagogical action that offers a contrast to the traditional academic, dominant and Eurocentric discourse in mathematics education. As well, it brings attention to school curricula often imposed on local communities during the process of colonization. It also challenges the view that members of local and/or distinct cultural groups only develop exotic and/or simplistic mathematical ideas, procedures, techniques, and practices.

In this context, the development of ethnomathematics can be interpreted to some extent as a reaction to cultural imperialism, which has spread around the world beginning in

 ISSN: 2717-5081 (Print); 2738-9529 (Online)

the 15th century with the movement of the great navigations. This reaction can be connected to the concept of positive deviance[1] (Zetlin et al., 1990) as it relates to the flexibility of rules and regulations in order to achieve a deeper understanding of what constitutes mathematical thinking and reasoning. In this article, the holistic understanding of positive deviance embraces innovative solutions in the ethnomathematics research and its pedagogical action because this program also relates to the flexibility of norms in the educational institutions.

For example, in a study conducted in Brazil, Duarte (2004) investigated the specificity of mathematical ideas, procedures, and practices produced by adolescent and adult construction workers who were also students in an evening adult education course. The results of this study showed that mathematical knowledge produced, developed, and transmitted in construction sites has important curricular implications inferred from this kind of knowledge production. It also studied the connections of the local knowledge along with the forms of academic knowledge legitimized by the school in order to determine curricular modifications. It was found that these connections had positive results in the development of mathematics curriculum in schools.

During investigations seeking to understand and comprehend the development of local mathematical knowledge, researchers and educators may be faced with a set of specific characteristics related to ideas, procedures, and mathematical practices that are different from those studied in the academy (Rosa & Orey, 2015). This aspect of positive deviance of ethnomathematics can assist in resolving ethical dilemmas encountered during investigations related to sociocultural issues.

Hence, the concept of positive deviance refers to the practices that, in an insubordinate, creative subversive, and responsible way, and with discernment, are opposed to educational practices that make no real pedagogical sense, especially in regards to the educational bureaucracies and traditions of public policies imposed on students and to the school communities. This refers to actions assumed in relation to norms and institutional rules which aim at better commitments in the needs of students who compose the school population (Rosa & Orey, 2017).

Both researchers and educators who are able to create innovative alternatives to achieve better results for the common good of the community and which are constituted by their colleagues, students, parents, school administrators, can be candidates for positive change (D'Ambrosio & Lopes, 2015). This action is often in opposition and generally represents a challenge to established authorities and long-beheld traditions, even if it they are related to, or cause unintentional exclusion and/or discriminatory school policies.

For example, a wide variety of mathematical procedures, strategies, and techniques challenge primitivist[2] views held by members of distinct cultural groups as ideas that possess simplistic mathematical knowledge used to solve problems they face in their communities. It also challenges epistemological stereotypes most damaging to these members. Thus, a sense of positive deviance becomes an important source for adaptive transformational capacities by members of distinct cultural groups that produce non-conformist actions. Its main objective is to modify these norms and rules by applying inclusion, innovation, creativity, and adaptability (Rosa & Orey, 2015).

[1]The concepts of *creative insubordination* (Crowson; Morris 1982), *responsible subversion* (Hutchison, 1990), or *positive deviance* (Zetlin et al., 1990) are equivalent as they relate to the adaptability of rules and regulations in order to achieve the welfare of the members of distinct cultural groups. However, there are subtle conceptual differences that must be discussed during the development of investigations.

[2]Primitivism refers to cultures believed to lack cultural, social, technological, or economic sophistication or development. Historically, primitivism has been used to justify conquering the members of *other* cultural groups. In cultural terms, primitivism means a deficiency in those qualities that have been used historically in the Western as indicators of civilized cultures (Rhodes, 1995).

Positive deviance refers to when researchers and educators gain a certain sense of awareness about when, how, and why to act against established procedures or guidelines that are unjust, racist, homophobic or unfavourable to any member of a school community. This means that individuals, who are positively deviant, according to D'Ambrosio and Lopes (2015), are subversively responsible because they assume that members of distinct cultural groups are unfinished human beings who take criticality, creativity, responsibility, and curiosity as the foundation of an ongoing and transformative process of the production of knowledge.

Ethnomathematics can be considered both a positive and deviant pedagogical action because it causes a certain disruption to the existing order in academic mathematics by encouraging and developing the study of the mathematics found locally including diverse mathematical ideas, procedures, and practices that are in accordance to the emic[3] perceptions of the members of distinct cultural groups (Rosa & Orey 2017). It is important to state that much of the antipathy towards ethnomathematics is precisely because it has broken the rules and bureaucratic expectations of traditional academic mathematics.

Through ethnomathematics, it is possible to recognize divergent ways, as well as value the diverse modes that mathematical knowledge is produced by other cultures and environments (Rosa & Orey, 2015). It is necessary to reclaim contributions of the conquered, minority, or marginalized peoples in the development of mathematical knowledge. Ethnomathematics generates a new respect for diverse forms of mathematical knowledge and assists in resolving ethical dilemmas involved in these investigations.

Therefore, a sense of positive deviance can be triggered by initiating a disturbance that causes a review of traditional or western academic mathematical knowledge by increasing the potential for growth and the emergence of new opportunities for the discussion of the nature of the mathematics curriculum. Positive deviance contributes to the confrontation of taboos or outright hostility towards assumptions suggesting mathematics is a universal[4] field of study without traditions and cultural roots (Rosa & Orey 2015).

Mathematical knowledge is acquired through unequal cultural interactions and conflicts, which reflect the dynamics of the cultural encounters. Ongoing, indeed universal, challenges that many educators face in mathematics education can develop methodological procedures that help teachers to understand culturally bound mathematical ideas, procedures, and practices developed by members of distinct cultural groups without letting their own culture interfere with the cultural background of others. In this regard, Rosa and Orey (2019a) affirm that many members of distinct cultural groups developed their own interpretation of the local culture (i.e., emic approach) opposed to the outsiders' global interpretation (i.e., etic approach) of that culture.

Contextualizing Positive Deviance and Ethnomathematics

Decision-making in the teaching and learning process contains multiple conditions of certainty, uncertainty, and risk. For example, many diverse pedagogical settings contain an infinite assortment of situations that require teachers to use technical skills, a professional

[3]The emic and etic approaches were developed by Pike (1967) from a distinction in linguistics between *phonemic* and *phonetic*. In their original meanings, phonemics refers to examination of sounds for their meaning-bearing roles in a particular language, while phonetics denotes study on universal sounds covering all languages.

[4]Universals can be perceived to the extent that members of distinct cultural groups order, count, pattern, problem solving, and model. However, how these members, outside of the academic world do and develop mathematical activities is part of the diversity that ethnomathematics seeks to study, share, and promote (Rosa & Orey, 2017).

code of conduct, and situation-specific knowledge. One size fits all mathematical standards may not be realistic for implementation of curricular activities at a local level (Rosa & Orey, 2017).

Teachers may be forced to deviate, react creatively, responsible, subversively in meeting the educational needs of their students. The term deviance can be emotionally charged, evoking a wide range of images and interruptions, most of them likely to be aberrant or elicit disapproval (Rosa & Orey, 2017). Thus, we propose that teachers use positive deviance to develop actions in order to deal with such situations because it "involves an intentional act of breaking the rules in order to serve the greater good" (Gary, 2013, p. 26).

However, deviations can be described as a normal part of the process of any work (Polet et al., 2003). The concept of positive deviance first appeared in nutrition research in the 1970s. Investigators observed that despite the poverty in certain communities, some poor families had well-nourished children (Zeitlin et al., 1990). Researchers suggested using information gathered from these families to plan alternative nutritional programs (Wishik & Van der Vynckt, 1976).

The term positive deviance has also been used in broadening the discipline of organizational behaviour (Dodge, 1985). Positive deviance is a term which is widely used throughout business, management, sociology, criminology, healthcare, and nursing. However, as concepts are a basis for theory building, an understanding of the notion of positive deviance may indeed contribute to development of innovative knowledge in the teaching and learning process that is linked to the cultural context of the students. Yet, it is important to state here that there is no uniform or consistent definition of this concept for educational contexts.

We understand positive deviance as the unprescribed practices or strategies that produce better outcomes than traditional standard practices (Pascale et al., 2010). This idea can be related to the teaching and learning processes in regard to the use of local techniques in mathematical thinking, measurement, and solving problems faced by members of distinct cultural groups in their daily lives. According to Tarantino (2005), an act of positive deviance becomes both intentional and honourable behaviour that differs from the established norms because it contains elements of innovation, creativity, and adaptability.

Ethnomathematics-based investigations have revealed the cultural influence in the evolution of world-wide mathematical knowledge through the study of historical accounts, which helped the analyses of ideas, procedures and mathematical practices developed locally, which are aimed at deconstructing the dominant mathematical discourse by offering innovative views about the nature of this knowledge (Ascher, 2002; Orey, 2000). Acknowledging local mathematical knowledge as well as its implications for social justice, cultural empowerment, and political transformation of a society triggers the development of positive deviance, and encourages debate about the true nature of mathematics as it relates to culture and society.

In this sense, positive deviance is used in this process when the norms and rules used in academic mathematics in these programs are inconsistent with the mathematical knowledge developed in terms of the local reality of the students. It is necessary to emphasize the pedagogical action developed in many mathematics curricula that ignore this important connection between academic knowledge and practices developed by community members.

Thus, to reduce the gap between theoretical and practical knowledge in the school curriculum, there is a need for teachers to query possible connections between the mathematical knowledge developed in local and community contexts and that which are practiced and supported by the academic environments. In this context, educators experimenting in positive deviance contribute to the generation of new ideas and develop a

respect for diverse forms of mathematical knowledge. As well, they assist in resolving ethical dilemmas involved in investigations in this area of study.

During investigations seeking to understand local mathematical knowledge, educators may be faced with a set of specific characteristics related to ideas, procedures, and mathematical practices different from those studied in the academy[5] (Rosa & Orey, 2013). They are professionals who accomplish the objectives and goals of the organizations such as schools and are crucial to the success of change efforts. Similarly, Fielding, Hogg, and Annandale (2006) affirm that positive deviants are exceptional and high achieving individuals who exceed normal or average levels of performance in a group. These individuals are "extremely resourceful, knowledgeable, and adaptable" (Clancy, 2010, p. 54).

This above discussion demonstrates that there is a need for educators to break the greater Western-Eurocentric perspective of what consists as mathematical knowledge. Hence, mathematical knowledge must be interpreted in the broader sense given that the term ethno is associated with members of identifiable cultural groups, such as national and tribal societies, working groups, children of a given age, individuals belonging to distinct professional classes, and marginalized and minority cultural groups (D'Ambrosio, 1985).

According to Rosa and Orey (2019a), this approach may assist this ongoing reconstruction process, which seeks to relate academic mathematics with sociocultural activities through the use of:

- Artifacts as observational objects created and developed by the members of distinct cultural groups. These instruments provide clues and information about its creators and users.
- Mentifacts as analytical tools such as thoughts, reflections, concepts and theories that represent the ideas and beliefs of the members of a particular cultural group, for example, religion, language, and laws.
- Sociofacts that represent the social structure of distinct cultural groups such as family and tribal structures. They can be considered as the patterns of interpersonal relations expected and accepted among the members of these groups.

This perspective aims to reduce prejudice, inequity, and harm due to ongoing disconnections between knowledge as practiced in the academy (etic) and its practical use in everyday life (i.e., emic). Positive deviance in mathematics curriculum and teaching can be seen as a responsible form of subversion that uses the theoretical and methodological apparatus of these investigations to reveal and combat the privilege and the authority that was granted to the academic mathematical discourse (Rosa & Orey, 2017).

This approach enables understanding and comprehension of how privilege and authority, stemming from colonization, have influenced the distribution of power in modern society (Fitzsimons, 2003). This context allows for the analogous use of positive deviance to conduct research in ethnomathematics in order to start a changing process in mathematics education by applying its pedagogical action. In this context, ethnomathematics helps students from distinct cultural groups to equally access academic mathematical discourse. This action also enables the identification of cultural traits[6] that are not frequently recognized by educational institutions as features of students' culture.

[5]Both approaches are good and, like learning languages, being *bimathematical* is good as well.

[6]Cultural traits can be considered as socially learned systems of beliefs, values, traditions, symbols, and meanings that members of a specific cultural group acquire throughout history. It is a deposit of knowledge, experiences, actions, attitudes, hierarchies, religion, notions of time, roles, spatial relations, concepts of the universe, and artifacts developed by the members of distinct cultural groups in the course of generations through individual and group strivings (Samovar & Porter, 2000).

For example, Rosa and Orey (2007) affirm that ethnomathematics investigates ways in which members of distinct cultural groups understand, articulate, and use ideas, notions, procedures, and concepts that can be identified as mathematical practices for the development of curricular activities. In this cultural dynamism, students are able to identify and decode the produced, transmitted, and accumulated local mathematical knowledge by having contact with academic mathematics in order to establish relationships and comparisons between these kinds of knowledge.

Therefore, the positive deviance aspects of ethnomathematics recognizes the specificities of the members of distinct cultural groups by emphasizing their mathematical knowledge systems, showing them in a dynamic way, and valuing them on their own terms and contexts. In this context, Lloyd (2011) states that it is important that researches, teachers, and educators describe the ideas and procedures that are implicit in mathematical practices locally developed by the members of these groups. In this sense, the research of these practices can be regarded as a position of resistance towards the imposition of academic mathematical knowledge as they may suggest actions in search of creative and innovative solutions to these challenges.

Aspects of Positive Deviance in Ethnomathematics

Researchers in ethnomathematics have revealed cultural influences in the evolution of mathematical knowledge through the study of historical accounts. For example, Orey (2000) argues that this approach helps the analyses of mathematical ideas, procedures, and practices developed locally, which aims to deconstruct dominant mathematical discourse by offering innovative views about the nature of this knowledge.

This context enables positive deviance to be developed because the norms and rules applied in academic mathematics are often found to be inconsistent with the mathematical knowledge developed in terms of the local realities, customs and needs. For example, Rosa and Orey (2015) emphasize that investigations in both mathematics education and mathematics have often ignored connections between academic mathematical knowledge and the practices developed locally by members of distinct cultural groups.

In order to reduce the gap between theoretical and practical mathematical knowledge, there is a need for both researchers and educators to query about possible connections found between mathematical practices developed in particular cultural contexts. The positive deviance feature of ethnomathematics recognizes both the uniqueness and diverse perspectives of members of distinct cultural groups by giving voice to, and emphasizing emic knowledge systems (Rosa & Orey, 2019b).

Ongoing investigations in ethnomathematics must describe the ideas and procedures implicit in locally developed mathematical practices. In this regard, Lloyd (2011) as they may suggest actions in search of creative and innovative solutions to these challenges, it affirms that research on these practices can be regarded as a form of resistance towards imposition of academic mathematical knowledge. In this regard, Rosa and Orey (2015) affirm that what is important are the results of these investigations that show that mathematical knowledge developed locally is worthy of recognition and appreciation by the members of the academic community.

For example, Pinheiro (2017) proposed an innovative ethnomathematics pedagogical action in the teaching and learning mathematics by deaf students. The methodology adopted in his study was related to the contextualization of everyday phenomena through which it was possible to negotiate meaning, thus, favouring the construction of mathematical and financial concepts of deaf students.

Positive deviance in the pedagogical action of ethnomathematics as well as in its research paradigm refers to behavioural, cultural, political, economic, environmental, and social changes premised on the observation that when members of distinct cultural groups confront similar challenges they employ uncommon, yet successful mathematical ideas, procedures, and strategies that enable them to find solutions to the problems they face in their own communities (Rosa and Orey 2017).

According to D'Ambrosio (2011), members of distinct cultural groups, in their search for transcendence and survival, develop explanations for problems they face, as well they collect information that makes for the creation of their own myths and mysteries, which help them to explain their sociocultural and natural environments by developing cultural artefacts. Material representations of reality (artifacts) organized in the form of language, art, and techniques are both observable and can be interpreted by the members of other cultural groups. In this process, codes, symbols, and representations are created by the development of mental representations that are shared by the members of distinct cultural groups through the use diverse artefacts that help them to constitute their own cultures.

Mathematical artefacts are first generated by the members of distinct cultural groups who interact with natural, social, economic, political, and sociocultural environments in order to resolve situations and problems, and to explain and understand mathematical facts and phenomena that occur in their day to day life (D'Ambrosio, 2011). Both artifacts and mentifacts are organized, transmitted, diffused, and shared with the members of other cultural groups.

For example, the results of ethnomathematics study conducted by Cortes (2017) shows that farmer vendors have their own artefacts such as manual scales and different packing of products that they develop their own mental calculations and distinct ways of determining the price, and diverse procedures to weigh their own products. One of the main results of his study was to provide innovative and integrative approaches to mathematics curricula that consider the origins of both local and academic mathematical knowledge through the development of ethnomodels[7].

Consequently, Rosa and Orey (2017) emphasize the importance of communities for schools, as it seeks to connect academic practices to mathematical knowledge developed locally. It is also necessary that the development of school curricula is designed to promote the valorisation of local knowledge and practices developed by the members of distinct cultural groups who integrate school contexts. This kind of positive deviance aims to reduce prejudice, inequity, and harm due to disconnections between mathematical knowledge as practiced in the academy and its practical use in everyday life.

This perspective provides a necessary balance to school curricula since it integrates cultural components in the process of teaching and learning mathematics. This approach aims at the humanization of mathematics through contextualized activities in ongoing mathematics curriculum development. This is one of the most important positive deviance features in the pedagogical action of ethnomathematics in schools. Consequently, the "teacher is challenged to introduce the cultural diversity of pupil's mathematical practices in the curriculum since pupils also use mathematical practices in their everyday life" (François, 2010, p. 1518).

According to Rosa and Orey (2017), this context allows for the analogous use of positive deviance to conduct research in ethnomathematics in order to start a changing process in mathematics education. However, it is necessary that professionals are willing to take the risks associated with that decision. This decision-making process is one of the most important components of positive deviance, which can be understood as a fight against

[7]Ethnomodels can be considered as small units of information rooted in sociocultural contexts, which are representations of reality that help members of distinct cultural groups to interpret and understand phenomena they face daily (Rosa & Orey, 2019a).

dehumanizing effects of bureaucratic authority that may occur during the conductions of investigations related to the ethnomathematics program.

According to Rosa and Orey (2019b), this conception of an alternative mathematics curriculum design is related to the access to the information of dominant mathematical discourses, which may provide critical reflections regarding to the application of the mathematics curriculum. In this context, the study of mathematical practices developed by members of distinct cultural groups can be considered as a resistance position of creative insubordination because such practices become innovative pedagogical trends for teaching and learning mathematics.

In this context, ethnomathematics emphasizes the importance of community to school because it seeks to connect school mathematics seeks to the practices developed locally. So, it is necessary that the school curriculum is designed to value and promote local knowledge and practices developed by the members of the communities that integrate school context. This perspective also provides the necessary balance to the school curriculum because the integration of these components in the mathematics curriculum enables the conception of Ethnomathematics as a program that aims at the humanization of mathematics through contextualized approach to the curriculum.

This particular curriculum exercise can be also considered as a resistance positioning because by using the data gathered from this study, educators are able to soften institutionalized teaching practices through the context of everyday activities by applying mathematical activities based on the ethnomathematics program. In this regard, Rosa and Orey (2007) stated ethnomathematics enables the development of teaching strategies that help educators to make methodological decisions related to their teaching practices in order to improve mathematics performance of their students. Thus, these professionals modify, adapt, and soften curriculum policies they believe are unfairly foisted to the members of the school communities.

Final Considerations

Mathematical thinking is developed and used in distinct sociocultural contexts with specific needs and ways of life. Thus, it is important to analyse the relation between culture and mathematics by questioning the predominant view that mainstream mathematics is culture-neutral. However, it is also necessary that both researchers and educators are willing to, indeed, be supported in, taking risks associated with the decision of using local mathematical knowledge in the mathematics curriculum.

This decision-making process is one of the most important components of positive deviance. Thus, this approach can be understood as a fight against the dehumanizing effects of bureaucratic authority that occurs during the conduction of research and investigations related to ethnomathematics as a program (Rosa & Orey 2017). There is no doubt on the importance of modern science and mathematics, yet, westernized mathematical knowledge has come to be primarily dominated by the capitalistic and often destructive preferences from European and North American science and its accompanying Eurocentrism.

This domination process poses many problems in mathematics education in non-Western and/or non-dominant cultures. In this context, it is necessary to recognize that D'Ambrosio (2006) stated that conceptions of mathematical practices have been imposed globally through the imposition of series of colonial intrusions as the pattern of rational human behaviour. By developing systematic studies by using ethnomathematics, it is possible to comprehend new contexts and perhaps skills that allow us to observe mathematical phenomena on more inclusive and broader wavelength.

The results may then lead us to new viewpoints in mathematics education in order and to improve cultural sensitivity in teaching practices. In this regard, we see ethnomathematics as the study of mathematical phenomena within a culture, and it differs from the traditional conception that considers it as the foundations of one kind of mathematics that is constant and applicable to everyone and everywhere. Mathematics then becomes a social construct because it is culturally bound.

This article discussed concepts of positive deviance from the perspective of ethnomathematics. This specific form of pedagogical action helps students to overcome the use of disassociated techniques and formulas often blindly memorized. As well, it allows them to develop strategies and techniques in order to give access to diverse mathematical representations in a new formative dimension of the mathematical nature. These pedagogical practices transcend physical environments in order to welcome knowledge and procedures developed in the diverse sociocultural contexts of students (Rosa & Orey, 2015).

In this approach, one important pedagogical action for the development of mathematics is related to the transformation of mathematics into a living knowledge that integrates real situations through questionings, analysis, and critical reflection of phenomena that occur in everyday life of the students. It is in the school community itself that researchers and educators can easily find didactic elements of mathematical content necessary in the development of mathematics curriculum (D'Ambrosio, 2006).

Positive deviance, especially in regard to an ethnomathematics program, can be considered as a tool to combat the dehumanizing effects of curricular and bureaucratic authority by decolonizing mathematical ideas, procedures, and practices in a search for peace. Thus, Rosa and Orey (2017) argue that the objective of this deviance is to ensure that curricular bureaucracies do not disservice students when public policies and institutional procedures have no real connections with the school communities.

Hence, there is a need to diversify teaching strategies used in the classrooms such as the use because there is no single recipe for improving the performance of students in mathematics. Thus, teachers need to be committed to innovative educational pedagogy in order to help students to reach their educational potential. This type of positive deviance can be considered as combat against the dehumanizing effects of curricular bureaucratic authority.

Of course, there is no single recipe for improving students' performance in mathematics. At the same time, educators and researchers need to be supported as they develop ethnomathematics through ethnomathematics that can allow them to implement innovative pedagogies that can help students to reach their sociocultural and academic potential, through a diversity of teaching strategies used in the mathematics curriculum, such as the use of ethnomathematics.

Acknowledgments

We would like to express our special thanks of gratitude to our guru, mentor and dear friend Ubiratan D'Ambrosio who is our great inspiration in developing our research as well as our writings.

Funding

There was no funding in relation to this article.

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Suggested Citation:
Orey, D. C., & Rosa, M. (2020). Connecting ethnomathematics to the concept of positive deviance. *Journal of Transformative Praxis, 1*(1), 25-35.

Open Access

Journal of Transformative Praxis

Vol. 1, No. 1, 2020, pp. 36-49
DOI: https://doi.org/10.3126/jrtp.v1i1.31759

Received: 9 February 2020; Revised: 9 April 2020; Accepted: 12 June 2020

Original Article

Holistic Orientation in Education: Transformative Art of Including, Connecting and Balancing

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Abstract

This study explores holistic orientation in education reflecting on practice-based accounts of educators with emerging pedagogical insights and implication conceptualized within transformative learning theory. Similarly, this study explores holistic orientation in education with a reflective praxis that advances collaborative self-narrative research incorporating personal reflections of educators seeking to nurture transformed ways of including, connecting and balancing in their pedagogical practices. In this study, educators with holistic orientations place emphasis on inner lives, balance, exploring dynamics of interconnections, trustful and authentic relationships, dialogues, concern and care as transformative initiatives in their pedagogical practices. Based on the guiding metaphor that what you see depends upon how you look, this article offers both descriptive and reflective insights into pedagogical reflections of educators that exemplify holistic orientations as a practical implication for transformative learning. The findings of this article indicate holistic orientations in education as a resonance educators experience and explore between why they teach and how they teach. More importantly, together with further implications for transformative research and education policy, this study aims to recreate possibilities for transforming educational practices with transformed ways of being, balancing, and relating of educators.

Keywords: *Holistic learning. Transformative learning. Pedagogical insights. Collaborative research.*

Holistic Orientations in Education: Exploring Unrealized Implication

When I reflect on my educational journey, I realize that the possibility of education remains more than mere transmission of knowledge or a transaction of knowledge between students

ISSN: 2717-5081 (Print); 2738-9529 (Online)

and teacher. Rather the purpose of education also needs to identify its transformative orientations, reflections and interconnections. As Lawrence and Cranton (2009) suggest, in their study on transformative learning, as a researcher I begin my search for holistic orientation in education resonating with their expression: what you see depends upon how you look. I have assimilated this expression as a guiding metaphor for this article, to reflect upon holistic orientations in transformative learning from the pedagogical expressions of educators in Kathmandu Valley.

As I observe in the context of institutional schools within Kathmandu Valley, non-traditional approaches, such as transformative learning and alternative pedagogy, have been gradually embraced as an example of progress, improvement or a shift in educational paradigm. Therefore, terms like holistic education, transformative learning, creativity and alternative pedagogies have found their significance within our institutional school system, their workshops, teacher training programs and seminars. Transformative learning, conversely, is not merely a concept or a theory, rather it implies to an existential process of being and becoming that requires different orientation towards teaching and learning activities altogether.

Moreover, as Palmer et al. (2010) remind us, we can transform our education system, not with another theory, a formula or with some sophisticated approach, but with educators prepared for a transformed way of being in the world. Similarly, from the perspective of transformative learning, a change of perspective in educational practices comprises transformative understanding of teaching self (Taylor, 2017). Hence, beyond theory, concept or a mere jargon, this study explores holistic orientation in education with educators seeking to sustain, nurture and recognize transformed ways of being in their educational practices.

Similarly, as a participant in different seminars, conferences, workshop and educational discussions, I have usually encountered expressions like transformative learning and holistic education in abundance. However, as Taylor and Cranton (2013) indicate, transformative learning theory no longer transforms itself, discussions, deliberations and presentations on different concepts and key expressions of transformative learning are not enough. Hence, transformative research needs to recognize and exemplify courage, entailing commitments and inner convictions of educators prepared to negotiate and act upon their purposes, values, feelings and meanings regarding their pedagogical practices rather than uncritically assimilated educational practices that they have assimilated from others (Mezirow, 2003). Therefore, by choosing collaborative inquiry as research methodology, this article consults primary sources for exploring how an educator envisions to transform lives with their pedagogical practices (Wagley & Luitel, 2017) and how these practices can be exemplified in a collaborative self -reflective journey with educators, as expressions and examples of holistic orientations with practical implication for transformative learning theory (Taylor, 2017)

More importantly, previous literature published within Nepalese context (Pasa, 2019; Pandey, 2019; Qutoshi, 2018) indicate a substantial research gap regarding research praxis related with transformative research paradigm. Previous studies have used auto-ethnographic research for exploring transformative experiences of educators in an educational journey, and this method has been used by only those researchers both theoretically oriented and methodologically competent to reflect upon their educational journey from the perspectives of transformative learning and self- reflective praxis. Similarly, auto-ethnography has been considered by scholars and researchers within education studies as a dominant method for transformative education and research (Qutoshi, 2015; Belbase et al., 2008). Beyond reflections of lone auto -ethnographers, this study is a collaborative research journey of researcher and the research participants to co-construct self-reflective narratives that enables participations to reflect on their pedagogical practices as holistic orientations in education.

Moreover, this study aims to create possibilities for collective auto-ethnography research that ensemble both personal and collective, besides solo-performances of auto-ethnographic study (Hernandez et al., 2017). Hence, this paper flashes out yet another direction for transformative research as a collaborative musical improvisation as an ensemble between researcher and participants.

Based on these observations and research gaps, in this article collaborative research method has been used to reflective on pedagogical practices of educators to explore and substantiate holistic orientations in transformative learning. Within transformative learning theory, Taylor (2017) recognizes holistic approach as an important construct that shapes the transformative experiences in education and recognizing holistic orientations has both research and practical implication for transformative learning. Therefore, the main purpose of this article is to enrich and stimulate our understanding of holistic approaches in education that recognizes the role of feelings, dialogues, inclusion and balance of perspective, other ways of knowing and teaching and trustful relationships in transformative learning process (Taylor, 2017).

The article discusses collaborative research that incorporates personal reflections of secondary and higher secondary educators associated with different institutional schools in Kathmandu Valley seeking to nurture ways of including, connecting and balancing in their educational practices. More importantly, this article aims to initiate transformative self-reflection that culminates into transformation of perspectives among educators and readers. This study encourages them to reflect their inner lives, balance, interconnections, alternative ways of knowing and teaching, inclusions, trustful relationships, feeling, dialogues, concern and care in their pedagogical practices. After all, as Hart (2014) argues, holistic orientation in education begins when educators take notice of their own inner lives and then find ways to invite students to do the same with pedagogical practices that recognize the role of relationships with others as an integral part of transformative learning process.

Literature Review and Theoretical Framework

This research builds on holistic orientation as an emerging construct with practical implication for transformative learning theory (Mezirow & Taylor, 2006; Taylor, 2017) that acknowledges role of feelings, awareness, different ways of learning and knowing, and dialogues among educators and their students in a reflective journey sustained by transformative relationship. After all, the role of relationships among educators and students in transformative learning has been increasingly acknowledged as transformative pedagogical practice (Taylor & Snyder, 2012). Hence, based on transformative learning theory, this study explores affective dimension of educators, their inner feelings, awareness, convictions, and commitments together with the relational aspects of their pedagogical practices in a research journey that reflects upon holistic orientations in education. For relational dimension, this study also argues that students still need a positive relationship with their educators, particularly when it comes to motivation and providing feedback (Dawson et al., 2018).

Similarly, this study recognizes core elements of transformative learning theory such as individual experience, critical reflection, dialogue, context, and authentic relationships (Taylor, 2009), as integral dimensions of holistic orientations in education. In this study, transformative learning theory has been used as a theoretical framework to explain pedagogical practices of educators as a part of learning process for constructing and appropriating new and revised interpretations of the meaning of an experience in different educational context (Taylor & Cranton, 2012).

Biesta (2007) argues that holistic, democratic or transformative orientation in education is not just about the transmission of knowledge, skills, and values, but is concerned

with the individuality or subjectivity the student, and their uniqueness as singular beings. Similarly, Harder, Robertson, and Maiden (2019) in their article on building holistic framework for transformational learning argue that holistic approach explicitly focuses on the four aspects of being, such as body, mind, heart, and soul, and the learning within this model follows four modalities: lecture-discussion, physical-recreational, experiential-relational, and reflective-meditative.

Within holistic orientation in education, transformative learning process focuses on different aspects of being and different modalities of teaching and learning process that enriches different dimensions of being students and educators share together. For example, lecture and discussion methods formulate mind or cognitive aspect of being whereas reflective or meditative aspect nurtures soul and heart. Therefore, from the perspective of holistic education, inter/connections at emotional, spiritual and relational spheres of being represent a foundation for transformative educational processes, where teacher and learner, teaching and learning are woven into a web of transformative relationship (Nakagawa 2000).

Moreover, Mezirow (1991), in an article exploring transformative dimensions in learning, suggests that meaning exists within ourselves, rather than in external forms such as books, and that the personal meanings that we acquire from our experiences are authenticated through human interaction and experience. Hence, based on ideas of transformative learning, this study also explores how as educators we reflect and interpret our lived pedagogical experiences.

Besides, Nodding's (2002) description of a relational self relates to holistic orientation in education as a responsive caring way of being that occurs when a self is understood as relational, encountering other selves, objects and events in the world, all of which infuse together in a meaning-making processes and this also considers caring relations as essential aspect of holistic orientation. And, this study recognizes relational dimension as integral part of holistic orientation in education. Moreover, as J. Miller (2007) argues, holistic orientation in education involves exploring and making connections, and it makes an attempt to move away from fragmentation to connectedness.

Taylor (2006) suggests that fostering transformative learning in the classroom depends on establishing meaningful and genuine relationship. Therefore, this study also explores relational dimensions in education as integral part of transformative experience. More importantly, this study also recognizes that genuine and trustful relationship between educator and student fosters holistic orientation in transformative learning. This study also reviews holistic orientation in transformative learning, from the perspective of relationships that enrich a sense of balance, inclusion and connection (J. Miller, 2007)

Similarly, Lederach (1996), in a study on transformative education theory for a holistic educational practice in school, indicates that the classroom would be based on understanding that sustains fair, respectful and inclusive process as a way of life, and envisions outcomes as a commitment to increase justice, seeking truth, and healing relationships. Furthermore, this study based on White and Nitkin (2014) argues that transformational learning is an outcome of transformational teaching, and for students to change their role, the role and responsibility of educators needs to change well. After all, without transformative teaching, transformative learning remains empty and unfulfilled.

Similarly, drawing from a work of Miller (2000), this study recognizes holistic orientation in education as humanistic and also spiritual critique of the dominant educational culture. Likewise, this study also describes inner integrity of educators as spiritual critique of dominant educational practices, and within this critique convictions and commitments for transformations also manifest. More importantly, this study acknowledges that educators with holistic orientations possess a capacity for interconnectedness and these educators are capable

of weaving a complex web of connections among themselves, their subjects, and their students (Palmer, 1999).

As article by Illeris (2014) suggests and this study also acknowledges, transformative learning needs to be defined by identity and the research on holistic orientations in transformative leaning needs to give examples on how the concepts of transformative learning and teaching identity of educator can mutually enrich each other. Hence, this study explores intersectional and enriching relationship between inner convictions of educators, their interconnections in the frame of holistic orientation and pedagogical practices that sustain transformative learning experiences between educator and their students. Similarly, as suggested by Nye and Clark (2016), acknowledging holistic orientations in education, this study also recognizes emergent collegial dialogues between educators and students within educational settings as transformative context that creates alternative and irregular opportunities where transformative learning can occur.

More importantly, considering Nepalese literature on transformative education research, Pasa (2019) as educator recounts his narratives of transformation from being then to being here, and journey from being a waiter to becoming a lecturer, as he considers himself as a potential organic intellectual as an outcome of his transformative educational journey. Similarly, Pandey (2019) also explores importance of transformative learning using auto-ethnographic study to document his lived educational experiences through stories in a self-reflective journey, understanding of his self, other selves, and cultures around him. Besides, Qutoshi (2018) in a study has created a space for self-study practitioners to think about how to engage with multi-epistemic approaches in order to experience transformative learning. Hence, building on existing literature on transformative research, this research focuses on collaborative research to reflect on transformative journey and experience of educators (un)aware of holistic/transformative orientations in conceptualization, yet resembling them in practice, in their art of doing, being and relating.

Research Design

This study is qualitative in its orientation and the search for holistic orientations in education emerges in a collaborative narrative research. Regarding research paradigm, this study orients towards post-positivist qualitative research, which gives opportunities for the researcher and the research participants to co-create knowledge (Denzin & Lincoln,2000). Based on collaborative narrative inquiry, this study engages in a process of creating new knowledge, reflections or realizations based on narrative experiences of educators in an educational context (Craig, 2001). In this study, the researcher aims to produce a reconstruction of participants' understandings and meaning they make out of their experiences (Denzin & Lincoln, 2000). This research encompasses multivocality and inter-subjectivity in a dialogical process, which enables self-reflexivity into individual narratives and co-constructs meaning, brining self-narratives of educators together towards a common experience (Hernandez et al., 2017). In this study, multivocality represents dialogical encounters between researcher and the narrative voices of educators culminating into inter-subjective interactions; hence, story version of the events for the teacher in this study has been recreated into narratives of lived experiences (Craig, 2001).

In the research process, I have concentrated on single entity-holistic orientation in a particular context giving way to a rich descriptive end-product to illuminate the reader's understanding by bringing about the discovery of new meaning through narrative expressions (Merriam & Simpson, 2000). Moreover, in this research, narratives recollected, reconstructed and reflected by the researcher entail a collaborative approach as both the researcher and his participants search for the presence of holistically orientated and transformative lived

pedagogical experiences of educators. In search for holistic orientation, this study focuses on thematic analysis because this research design allows participants to describe their lived experiences and for the researcher to explore themes emerging with meaning units that resonates with holistic orientations in education. In this study the researcher has thematically assimilated reflections of educators emerged as data within three categories.

In this small-scale case study, all the research participants (N=8) have teaching experience of above ten years in high school education (grade 9-12, GCE A-Levels). They were briefed about the purpose of the study and they expressed their consent for the interview. Educators (N=8) recognized as research participants in this study include, mathematics educator (n=1), general paper educator (n=2) social studies educator (n=2), economics educator (n=1) and business studies educator (n=2).Similarly, the researcher had informal group discussions with students (N=10) of research participants to reflect on pedagogical practices of educators. Narrative expressions of students have been used to exemplify discussions in this study. Besides, it is important to mention that my research participants, prior to the timeframe with me, were unaware of the conceptual framework for holistic orientations in transformative learning. The researcher collected data for around the time period of six months through interviews, informal discussions, group discussion with students as a progressive research journey culminating into essential explorations.

Since thematic analysis can either be inductively or theoretically conducted (Braun & Clarke, 2006), to explore essentials of holistic education the researcher has used in this study principles of holistic education as formulated by Miller (2007), who argues that holistic orientation involves exploring and making connections, as an attempt to move away from fragmentation to connectedness. After content analysis, relevant expressions of educators have been combined and illustrated into three mutually inclusive themes for further exploration. Miller (2005) has described three basic principles of holistic education: connectedness, inclusion, and balance. Hence, based on principles of holistic education formulated by Miller, this study has explored holistic orientation in education as practiced by the research participants. Here, connectedness refers to fostering interconnections among different polarities such as self and subject, formal and non-formal learning orientations, classroom environment and outside world, relationship between educator and students. Likewise, inclusion refers to including students of differing socio-cultural backgrounds and varying levels of abilities into teaching and learning practices without labeling or discriminating them. Lastly, balance refers to finding harmony between being and becoming and also between inner-self and teaching-self of educators (Palmer, 2009)

Moreover, in this article, I have evaluated perceptions of educators regarding their pedagogical practices in an interactive interview process. The collected data was analyzed and regrouped into identified themes of balance. The process of analyzing responses consisted of identifying significant statements that conveyed participants' experiences, and such information categorized based on three main themes for analysis (Creswell, 2012). Meanwhile, narrating their subjective vignettes, participations in this study engaged in dialogue with the researcher recollect their lived pedagogical experiences, which were weaved together as thematic explorations. This research builds on conceptualization of transformative education research as flashed out by Luitel and Wagley (2017), which includes recreating meaning-making from collaborative interactions, with subjective truths in a given context together with research participant.

Findings: Realizing Together- Holistic Orientations in Transformative Learning

In this study, lived pedagogical experiences of educators have been described to gain insights regarding their convictions, commitments, contexts, struggles, awareness, dialogues and

sense of identity. Transformative learning, as Mezirow (2009) indicates, problematizes frames of reference within fixed assumptions and expectations within educational practices to make educational orientations more inclusive, non-discriminating, open, reflective, and holistic and make both students and educators emotionally able to change. Subsequently, in this study educators are prepared to critically reflect on various assumptions and beliefs about teaching and learning process and also make conscious effort within ourselves to understand and explore other dimensions of knowing, learning, being and relating.

In a collaborative research journey, the researcher and research participants have scrambled towards understanding of holistic orientations in education with reference to connectedness, inclusion, and balance (Miller, 2005). These three dimensions for thematic explorations are disruptive as they challenge uncritically assimilated perspectives of educators (Mezirow, 2000) away from their regular habits of educators positioning themselves as exclusive, different from learners, transactional, indifferent and distant in their pedagogical practices. And, as educators speak their lived experiences; this study illustrates their thoughts, feelings, emotions, struggles and reflections in a collaborative study that combines their experiences and my interpretations within theoretical/conceptual framework of transformative learning. In this study relevant expressions of educators have been interpreted under theme description of connecting, including, and balancing.

Connecting

As Belenky and Stanton (2000) describe, transformative learning is indeed a relational process. This is to say, holistic orientations in transformative learning seek for emotional interconnections and relational dimensions in education. Regarding connectedness, a participant indicates: *As educators we need to realize that nothing happens in isolation; personal growth, emotional wellness, creativity, moral development, social competency, physical well-being, and intellectual growth of educators and students are interconnected with overall education practices in a given context that guides society, culture and policies.*

Another participant rather lucidly expresses: *I share stories, anecdotes, vignettes, examples and inspirations with my students so that they realize how different human pursuits, achievements, events, concerns and behaviours are interrelated, and why and where they stand among scheme of things. I encourage my students to understand interconnections between ecology, economics, society, politics and their subject matter. Truly what they are learning matters and it can make a difference in their lives.*

When an educator explores interconnections between subject matter, interests of student and external realities, they recreate their teaching pedagogy as more explorative and engaging (Miller, 2007). Reflecting on interconnections, an educator reflects: *I see oral presentations, group discussions, debates and dialogues as an arena for interconnections between outside realities and classroom learning, between confusions and clarities, differences and similarities and, more importantly, between agreements and disagreements.* Hence, as exemplified, educators with holistic orientations engage into transformative learning by bringing and interconnecting outer realities of existence into classroom discussions, debates and dialogues to engage students for critical questioning and the deliberate presentation of points of view that are contradictory to yet complementary with each other (Cranton, 2006).

Balancing

Similarly, regarding balance, an educator indicates: *My profession as an educator is a bridge that creates balance between my being and becoming, and I acknowledge my students as*

pilgrims journeying together in a sacred vocation. Being a teacher is not my mask. I am an educator, and there is harmony between my inner life, relationships and outer aspirations. Hence, when a student calls me a teacher, I feel that voice resonating with my being; I am indeed an educator. I am a teacher; therefore, I teach. For me, why I teach finds congruence with how I teach. As Cranton (2006) argues, educators spend their days rushing from task to task and the question remains how often we as educators stop to think about who we are as educators. Are we seeking balance between our own being and becoming, before expecting it from our students? Therefore, it is necessary for educators to engage in self-reflective practices, which enable them to gain insights regarding inner voice as an educator.

After all, without balance between being and becoming of educators, critical self-reflections that sustains deep shift in perspectives and regular reactive habit of educators remains indeed as hollow and unfulfilled. Therefore, Palmer (2009) argues, educators can certainly teach effectively and efficiently using different techniques, but education and learning does not truly begin until the teacher is able to connect and find balance with his/her teaching self with their inner self.

Furthermore, regarding balance, an educator expresses: *Sharing my own personal stories lets them see a glimpse of who I am and not only as the teacher but as a human being who stands in front of the classroom. That's my way of balancing the scale of relationship with my students. I have my struggles and anxieties as a parent, husband, friend, community worker. I relate the stories from when I was a student just like them, to make them realize we teachers are too humans after all and we are on the same boat together.* In fact, when it comes to finding balance through sharing personal stories, Kroth and Cranton (2014) suggest that storytelling enables educators and learners to understand the process of transformative learning through first-hand accounts of others' transformative experiences.

Moreover, in the midst of accountability, assignments, evaluations and standardized tests, holistic orientation in education seeks for a balance among different imbalances that occur between teacher and student and content and process. Regarding search for balances among different imbalances, an educator indicates: *I remind my students to read and search about subject matter discussed in the classroom from different sources, apart from prescribed course books and reflect on their specialized subject together with socio-political and economic realities emerging outside the walls of classroom.* Similarly, from the perspective of transformative learning, an adult educator realizes that different learners engage in learning in different ways, or the same individual may engage in learning differently depending on the content and context of the process (Kroth & Cranton, 2014).Hence, an educator with holistic orientation needs to explore and find balance among different alternative pedagogical practices to sustain diverse learning possibilities.

Including

Regarding inclusive pedagogical practices, a research participant mentions: *I often sit together with my students in small circles during recesses as co-inquirer listening to their perspectives. I need to include them within my educational practices as much as possible. Many students in my classroom feel that they are deprived of love and I believe this is the root of violence, indifference, carelessness of our students. I see my students as friends.* Moreover, as Clark (2005) suggests, transformative learning cannot happen without friendships, perhaps because many people most often turn to their social relationships to work through their everyday life events and shifts in perspectives.

Similarly, another educator reports: *I seek to maintain inclusive values in educational settings and students, irrespective of their performance or lack to it, are to be respected as human beings first.* Besides, as Greene (1995) describes, seeing people as small creates space

for exclusion, where academic non-performers or underachievers are seen as small marginalized or irrelevant students, and as educators we look at them from a detached-distant perspective. However, from the perspective of holistic orientations, we see all learners as big as we see them in their full humanity and worth.

Moreover, as Cranton (2006) states, when an educator sets up an environment and learning context in which people critically question their habits of mind in order to become open to alternatives, it culminates into emancipatory learning. In this regard, an educator expresses: *I have included critical thinking and reflective writing beyond regular habits of merely giving instructions and lectures, in my pedagogical practice because it enables students to question their prejudices, half-truths and ignorance. We discuss and debate in an inclusive way, recognizing differences and divergence in thoughts and emotions.*

Furthermore, an educator reveals: *I engage in dialogues for exploring inclusive and interactive ways of knowing with my students. We as educators become exclusivist when we deny or postpone dialogues with students. The more I reflect, the more I realize that being a student and an educator is two sides of the same coin; both include one another.* Regarding inclusion through dialogues, Blalock and Akehi (2018) argue that the process of dialogue can be a way for people to connect around shared experiences that can further connect individuals around an inclusive commonality. Dialogues enable transformative learning by creating a context for learners to feel connected and also included within the educational process. More importantly, engaging in dialogues reflects pedagogy beyond exclusionary practices.

Similarly, qualitative narratives of educators collected, illustrated and reflected in this study are comparable with a study by Conti (2002) that indicates: (i) holistic orientation in education emphasizes the idea of connectedness, which is to say--*My identity and inspirations as a teacher are knotted with aspirations of my students*; (ii) educators use convictions of their inner life as source of their pedagogy practices -- *When I enter inside the classroom, the first thing I tell myself is that I can make difference in the lives of my students through my inner qualities of care, support, concern, empathy and patienc*e. (iii) educators view teaching as an inner calling -- *My profession as an educator is a bridge that balances between my beings and becoming;* (iv) educators believe that much of their success depends on their own authenticity as whole persons -- *I believe, teaching becomes transformative when I find that my students realize their passions and their enthusiasm resembles my inspirations for them.* Besides, as Christiaens, Abegglen, and Gardner (2010) mention, educators oriented towards holistic education focus on self-care, person care, touch, and lifelong learning. Likewise, research participants in the study are also exploring application of these concepts in their pedagogical practices.

Discussions

In this study, thematic explorations of narrative expressions within the theme of connecting reveal that search for authentic and trustful relationship between educators and learners establishes foundations for holistic orientations in transformative learning (Taylor, 2007). It is through building relationship educators engage with their learners at affective level. More importantly, authentic and trustful relationship allows individuals to have discussions openly and achieve greater level of mutual understanding. Taylor (2017) mentions that holistic orientations in transformative learning recognizes the role of feelings, other ways of knowing and the role of relationships with others. Similarly, in this study educators are including different ways of knowing in their pedagogical practices, finding balance between their inner aspirations and outer performances and including their students in dialogues and discussions irrespective of all the differences.

As Slavick and Zimbardo (2012) indicate, transformational teaching involves more than creating lesson plans for adult learners, as it needs to bridge dynamic relationships between the teachers and adult learners, creating a shared knowledge base, and enriches learning and growth. Hence, educators in this study, with their connections, balance and inclusive orientations seek to enrich their students in a dynamic, trustful, respectful and authentic relationship. In this regard, reflections of students also exemplify importance of authentic relationship in education: *our educator applies multiple classroom discussions and dialogues to solve complex issues arising within subject matter, and more importantly, our teacher as a guide encourages us to evaluate what we already know about the subject matter before telling us to learn those concepts we are unaware before the interaction. We feel the presence of educator as a matured friend or as a family member.*

Educators in this study are seeking for dialogue when helping individuals create and maintain a comfortable sense of self, during a time that may be uncomfortable for them (Cranton, 2006); and by engaging the affective dimensions of their students they are providing an opportunity, for establishing a dialogue that expresses through various images, feelings, and behaviors within the learning setting (Dirkx, 2006). Regarding affective dimension a student argues: *my perspective regarding education has transformed, as I realize that my educator understands and acknowledges me as human being with emotions, feeling and moods. While discussing with my educator, I feel a sense of comfort and inclusion because I can dialogue with him as we both speak and listen.*

Moreover, this study also emphasizes the importance of teachers bringing their own experiences into the classroom and linking them to the academic discussion. Besides, in a study, Kreber (2004) concluded that when teaching, teachers also need to be more concerned with why they teach than with how or what they teach. And, the findings of this study within the theme of balancing also suggest that holistic orientations in transformative learning emphasizes on educators to reflect, explore and find balance between why they teach in resonance with how they teach. Similarly, Kathleen, Lisa Harrison, and Hurd (2018) also indicate that transformative process in education requires educators to understand the deeper sense of inner self and world around them and a transformative educator needs to perform re-examination of their dispositions, practices, and ways of thinking and being.

As an implication, this study suggests that for reforming profession of teaching, even in the context of Nepal, education policymakers have overlooked the possibilities of teacher's sense of purpose in educational change and transformations (Hargreaves & Fullan, 1998). This study also claims that transforming education involves purpose, passion, inspirations, convictions and hopes of educators. Moreover, this study recommends, according to Palmer (2003), that educational institutions need to create settings where teachers feel comfortable to discuss and to reflect on questions related to meaningful living. Similarly, based on the findings exemplified within the theme of including, this study also suggests that for transformative change to occur, sustainable teaching and learning must move beyond traditional methods of education and become more inclusive in which individuality, intellectual rigor, rationality, diversity and different orientations and exploration regarding transfer of knowledge are privileged in the educational process (Burns, 2011).

As another implication, comparable with study by Yacek (2020), this study identifies that the term transformative education has become commonplace within the educational research community in Nepal, and it has great potentialities for transforming education. However, sustaining transformative education requires deep psychological restructuring on the part of both educators and students. More importantly, for transformative research praxis, this research implicates further research on how educators challenge and question their beliefs as educators to recreate structural changes in their educational orientations (Mezirow &Taylor, 2006).Transformative praxis research needs to explore genuine desire of educators

to negotiate new frames of reference in a collaborative research for creating transformative possibilities in education.

Conclusion

This study, reflecting on practice-based accounts of educators, reveals that holistic orientation in education seeks for a caring, open, non-authoritarian relationship between people, which leads to genuine learning through various expressions of personal convictions and pedagogical practices. Specifically, establishing relationships between teacher and student is an essential dimension of transformative learning (Taylor, 2017). The transformative relationship between student and teacher allows both having discussions and dialogues, share information openly and achieve mutual and consensual understanding. Besides, the findings and discussions illustrated in this study support the notion that the art of including, connecting and balancing can be transformative experience for both students and their educators.

This study also suggests that the role of an educator is to enable students to explore their own essence by exposing them to various paths and possibilities they may take in life. Hence, educators need to understand their personal lives and the meaning they have constructed from their personal experiences (Owings, Kaplan& Chappell, 2011). Besides, this study encourages educators, in relation to their education practice, to recreate transformative context that shapes transformative learning (Taylor, 2017).

And, more importantly, this article expects, as Geofroy et al. (2019) also indicate, that teachers need to understand themselves as emancipatory agents, take responsibility for their individual growth because after all they have understandings of their subject-discipline and with their transformative pedagogical practice they have potentialities for exploring emancipatory possibilities in education. Besides, this research concludes that occurrences of holistic orientations and transformative learning in education have been sustained by educators of multiple disciplines even without recognizing or naming their pedagogical practices as transformative. Hence, as future inquiry for exploring other possibilities, this research has flashed out collaborative research between those educators/researchers deliberately fostering transformative learning and those educators informally sustaining, questioning and exploring a shift in perspectives regarding their pedagogical practices.

Funding

Researcher has not received any financial support for the research, and publication of this article.

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Suggested Citation:
Ojha, G. (2020). Holistic orientation in education: Transformative art of including, connecting and balancing. *Journal of Transformative Praxis, 1*(1), 36-49.

Open Access

Journal of Transformative Praxis

Vol. 1, No. 1, 2020, pp. 50-60
DOI: https://doi.org/10.3126/jrtp.v1i1.31760

Received: 1 April 2020; Revised: 1 May 2020; Accepted: 12 June 2020

Original Article

Moments of Critical Self-Reflection of a Transformative Mathematics Teacher

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Abstract

I have been travelling through a transformative research journey since the beginning of my MPhil study. It allows me to understand my past and present strengths and limitations in learning and teaching of mathematics, thereby envisaging alternative practices for futurist education. As my research involved critical self-reflection on my professional praxis, I used a multi-paradigmatic (interpretivism, criticalism, postmodernism) research approach and autoethnography as a research methodology. Thus, the main purpose of the paper is to portray the moments of critical self-reflection on my experiences of doing mathematical activities during my childhood and learning mathematics during my early days of schooling, aiming at improving my practices as a teacher, a practitioner-researcher and an educator. I used Habermasian knowledge constitutive interests (i.e., technical, practical, and emancipatory) and Schubert's curriculum images (i.e., content or subject matter, experiences, cultural reproduction, etc.) to interrogate my experiences of doing and learning mathematics. As a mathematics teacher and practitioner-researcher, reflections on my childhood experiences as well as early days of schooling ultimately opened up somewhat closed box of my personal and professional practices. This paper in/directly indicates the enhancement of the students' engagement in mathematics through context-based activities. Moreover, the selection of the contents should be based on learners' experiences which might be experienced through mathematically rich activities such as games, daily household works, etc.

Keywords: *Mathematics curriculum. Transformative mathematics education. Critical self-reflection. Autoethnography.*

ISSN: 2717-5081 (Print); 2738-9529 (Online)

Introduction

Curriculum, in general, and mathematics curriculum, in particular, is taken as important teaching and learning material. Curriculum is a part of the common phraseology which teachers and students need to encounter regularly (Fraser & Bosanquet, 2006). In the Nepali context, a very small number of mathematics teachers working in public and private schools seem to have implemented the curriculum with certain revisions and modifications because of its prescriptive and desk-based approach of curriculum development which leads towards decontextualization (Luitel, 2018). The modification of the mathematics curriculum done by teachers might be based on the students' experiences, prior-knowledge, and daily activities. In such a curriculum, the pedagogical and evaluation systems are likely to be more flexible and accessible for different students. In this scenario, as a mathematics teacher of a private school, I emphasize making context-based and experienced-based curricula, so that teaching and learning mathematics looks more engaged and student-centred. The majority of mathematics teachers, other subject teachers, and school leaders give more priority to the completion of the recommended course relying on textbooks and guidebooks to prepare them for the summative evaluation. The examination-driven mathematics curriculum in practice by mathematics teachers and other stakeholders in Nepal is likely to demote them from scholars and intellectuals to technicians in service to state (Pinar, 2004). Moreover, Nepali textbooks include unnecessary readymade algorithmic problems that are subject to criticism because of their decontextualized nature (Luitel, 2018). The intention of such an act might be to prepare students for summative evaluation rather than exploring and enhancing their creativity, imagination, communication skills, leadership skills, and real-life problem-solving skills.

In this context, firstly I discuss the theoretical orientation and methodology that I employed in conducting this study. Second, I reflect on my experiences of doing mathematics during my childhood. Thereafter, I reflect critically on my experience of mathematics during my schooling aiming at improving my practices as a teacher, practitioner-researcher, and an educator. Tutak, Bondy, and Admas (2011) argue that "critical reflection can lead to critical consciousness, which enables people to understand their lives in new ways and consider ways to change systems that routinely oppress particular groups" (p. 66). Thus, this article enables me as well as other mathematics teachers, researchers and policymakers to reflect on their existing pedagogy as well as curriculum development process, thereby envisioning alternative practices in pedagogy and mathematics curriculum development.

Theoretical Orientation

During my research, I employed a range of theoretical perspectives to catalyse my critical reflective thinking. Among them, Habermasian theory of knowledge constitutive interests (Grundy, 1987) is one of the theoretical lenses that I employed in this article by combining Schubert's (1986) theory of curriculum images with narrative portrayals of key moments of my autobiographical journey as a student of mathematics. The main orientation of technical interest is to control the environment based on the law-like rules, whereas the orientation towards practical interest is meaning-making and understanding the context, and the emancipatory interest critiques the law-like rules and status-quo governing the society, thereby striving for autonomy and empowerment. Thus, knowledge constitutive interest enabled me to conceptualize my narrative and experiences from the lens of technical as well as practical interest and led me towards emancipatory interest.

Fraser and Bosanquet (2006) argue that technical interest focuses on structuring and managing objects and environment, whereas practical interest aims to analyse and clarify human experiences, uncovering meanings, prejudices, and presuppositions. Moreover, the

essence of emancipatory interest is to struggle towards emancipation, challenge normal understandings and practices, and enable teachers to change the constraint of the environment. More specifically, the images of curriculum as content, programme of planned activities, intended learning outcomes, discrete task and concepts, and cultural reproduction as discussed by Schubert (1986) are likely to align with the technical interest, whereas curriculum as experience, agenda for social reconstruction, and currere, also discussed by Schubert (1986), are likely to align with the practical and emancipatory interests.

Methodological Orientation

Arriving at this stage, as a mathematics teacher and teacher educator, I came to realise that I need to reflect critically on my learning experiences thus far, not only to reveal and conceptualize my experiences of learning, but also to empower my agency as a school mathematics teacher (Rahmawati & Taylor, 2015), thereby enabling me to rethink during the selection of the content and pedagogy. In addition, I thought that my unpacking of narratives and stories would be a milestone for improving my professional practice and that the verisimilitude of these narratives might make my readers thoughtful about their own teaching approaches by reflecting on their perceptions and practices of mathematics and its pedagogy (Pant, 2019). I found autoethnography as the most suitable methodology that enabled me to unpack my past and present experiences of mathematics curriculum, pedagogy, and assessment in my MPhil dissertation (Luitel, 2020).

As an autoethnographer, I wanted to explore the work of a researcher (i.e., myself) and to focus on my experiences of the other (Ellis, 2017). This paper critically reflects on my experiences of mathematically rich activities during my childhood and learning mathematics during the early years of my schooling. I interacted critically with my 'self' as well as others' practices and described and analysed systematically (i.e., graphy*)* my personal learning experiences (i.e., auto*)* in order to understand cultural practices (i.e., ethno*)* (Adams, Jones, & Ellis, 2015). Indeed, autobiographical self-reflection is a powerful way of re/thinking and re/envisioning my present and future pedagogical as well as curricular practices (Taylor, 2008; Taylor & Settlemaier, 2003), which may be equally important to others to re/envision their curricular and pedagogical practices.

My Childhood: Enjoyed Mathematics Without Official Curriculum

Let me narrate my journey by unfolding my passion for mathematics since my childhood days. The place where I was born and grew up is in the eastern part of Nepal. Diversity of people and their culture with mathematical rich activities were one of the attractions of the village. Unknowingly, those mathematically rich cultural activities helped people to develop mathematical skills day by day. Very few people were educated through formal education but had a good sense of numbers, and were forward in estimation, guessing, and calculation. When I was about four years old, my elder sisters taught me mathematics beginning with counting the numbers. As I grew up with a single parent, they had the main challenge to teach me and prepare me for school education. However, I felt lucky to get siblings as friends with similar age groups. We enjoyed games and activities (discussed below). Before getting formal education, I learned about the counting of numbers, simple addition, subtraction, etc. during the interaction with my relatives, friends, and other known and unknown persons. Those who came to my home, they frequently asked about my schooling and asked some questions related to the multiplication table of the specific number, simple addition, subtraction as well as divisions, such as $2 + 2 = ?, 3 \times 5 = ?, etc.$ They would be happy when

I could tell them the correct answer and they would suggest that I should memorize in case of giving the wrong answer.

Arriving at this stage, my queries are like these: why was their focus only on numbers? Why not questions from other subjects like Social Studies, Nepali, and Science? Why did they not tell me the real-life application of the basic operation of mathematics? Every evening, before going to bed and every morning after having food, I did something related to mathematics which was assigned by my parents. Sometimes, they gave me the mathematics textbooks used by my sisters during their schooling and sometimes they prepared some mathematical problems and assigned me to solve them.

After the completion of the studies for bachelor's degree, I became a mathematics teacher in 2014 and at the same time, I got enrolled in a University for higher studies. Since the beginning of my master's study, I started to observe the teaching not only from the perspective of the teacher, but also from the researcher. So, as a teacher-researcher, I came to realize that people often think mathematics is represented through the routine problems and needs to reproduce same routine problems to the next generation, which might lead to the images of mathematics curriculum as cultural reproduction as discussed by Schubert (1986). The role of mathematics teacher guided by such a notion of curriculum is to control and manage the classroom environment by assigning the routine algorithmic problems, which is aligned with technical interest. In addition to this, both the teachers and students give importance to mathematics textbooks and the readymade problems mentioned in them. Though curriculum reforms have been taking place in Nepal, mathematics has not yet been able to integrate the cultural capital of the students (Shrestha, 2019). Thus, my questions here are, why did they not create their own mathematical problems related to their daily activities? Why did they not promote creativity as well as imaginative thinking in mathematics? Why were they so much interested in or focused on readymade problem-solving? Was there any hidden interest or necessity of giving such kinds of mathematical problems?

Culture is an important concept in my research. It seems that the culture is shaped in such a way that it promotes the idea that mathematics is created by the Westerners and prescribed to us. In this context, I agree with Wagle, Luitel, and Krogh (2019) that contextualized teaching and learning has not been a priority of school education in Nepal and the use of locally available resources for teaching and learning has continuously lost position in the education circle. Indeed, the effect has been seen in teaching and learning mathematics, too. In that situation, there was no other option than to become habitual to use books, notebook, and solve mathematical routine problems given in the books. Besides, I still remember my happiness when I got chocolate after telling the correct answer or properly solving the problems and memorizing the multiplication table from one to ten. This was what motivated me to engage in such types of mathematical problems. I liked to solve problems given in the book rather than the work given in the exercise book. Likewise, I loved to gather and play mathematically rich activities, such as games, shopping, negotiation, etc. which are narrated below.

My Daily Routine: Engaged in Mathematically Rich Activities

Let me share my daily work when I was a child – even before I started going to school. The activities each day and every minute and hour that I had done during my childhood with my siblings and friends were precious and made my life valuable and mathematical. They taught me different senses of mathematics (e.g., the sense of four operations, estimation and guessing, etc.) and mathematical skills (e.g., measurement, drawing and colouring, etc.), which are relevant to my personal and professional life in helping to envisage better pedagogy in mathematics. I have presented those experiences through a narrative below.

I wake up early in the morning. I would take milk and biscuits and sometimes beaten rice. Once my elder sister gave me a mathematical problem on the paper as well as giving a mathematics book of grade one too, I enjoyed looking at the picture and doing the mathematical problem given in it. I took lunch. I looked around and started to cry when I realized that my young sisters (uncle's daughters) are not around. This is like the daily routine that I follow. Most of the time, I played with them as their ages were similar to mine. We played games together. It was one of our traditional games known as Ghati Katte. At least, two players were needed to play, and we played it turn by turn. For this, we drew eight rectangular boxes on the ground and a small piece of stone was needed, in which two of the rectangles were big and divided into two equal rectangles. We just estimated the area of a rectangle to make it equal. To play this game, the players (we) threw a piece of stone into one rectangle and the player had to jump into different boxes trying to get the stone, go through the end and come back again. The player had to start throwing the stone number by number. Similarly, sometimes in my childhood, my uncle took me to the traditional domestic animals' market; my mother took me to the shop for my clothes and shoes. I observed the way they shopped. They bargained the prices all the time with the shopkeepers. I loved to accompany them to spend our family's limited money, and I was happy when we went back home with nice clothes, domestic animals (goat, cow, etc.). It seemed that we had successfully done our shopping.

I came to realize that mathematics played an important role during my childhood. Unconsciously, I learned mathematical skills such as measurement, the concept of near and far, more or less, short or long, estimation and guessing without any official and structured mathematics curriculum. I applied those concepts informally whilst playing and shopping. Informally, I learned mathematical symbols and operations with the guidance of my family, relatives, and friends. However, I did not realize that mathematical symbols and operations were related to my playing and shopping. Also, I could not disclaim that my habit of practising traditional games assembled my understanding of mathematics. I learned these as "the embodiment of local wisdom" (Pranoto & Hong, 2014, p. 71 as cited in Mariana, 2017), such as freedom of expression, a sense of friendship and togetherness whilst dealing with important conceptual issues (Mariana, 2017). Besides these, the game I played depicted the process of hard work and shopping with my parents represented different mathematical operations in a real situation.

Arriving at this stage as a mathematics teacher and researcher, remembering the above discussion or looking retrospectively at my childhood, I want to construct the images of mathematics as a (language) game in which unknowingly I learned mathematical skills through using mathematical language. In this context, I remember the paper by Lerman (1990) entitled "Alternative Perspectives of the Nature of Mathematics and Their Influence on the Teaching of Mathematics." Actually, I came to know that fallibilism or the fallibilist nature of mathematics leads teachers and students or other stakeholders to move beyond the algorithm, routine problem, and rote memorization, whereas the absolutist nature of mathematics talks about mathematics as particular, fixed, certain, value-free, and abstract subject. Lerman (1990) highlighted that the mathematician and philosopher Wittgenstein's philosophy of mathematics as a "language game" might be the source of fallibilism. I have realized that whichever games I played during my childhood, whatever dialogues and communication I heard during social activities (i.e., during shopping) were mathematically rich and played and have been playing an important role in my life. Were they depict the nature of mathematics as fallibilistic subject matter?

As there was no prescribed curriculum and structured plan or routine to do those activities, we ourselves generated some rules and regulations based on our experiences, which made us comfortable to play and run the activities. As the notion of practical interest is towards understanding and meaning-making, rules were based on the context and set based on mutual understanding. It is likely to serve the essence of images of the curriculum as an experience and our interest was to experience the mathematical senses that ensue from the dialogue between each other (Schubert, 1986). Moreover, the bargaining upon price during buying and shopping the things in the market ended with a mutual understanding of the customer and shopkeeper. I came to realize that people who were often involved in mathematically rich activities challenged the technical rationality, thereby guided by practical interest. Practical interest is an interest in understanding the environment so that everyone can adjust and interact with each other (Grundy, 1987). Thus, we tried to make the environment comfortable to enhance our goal. Moreover, we used the practical interest to generate communicative knowledge constructed from inner heart amongst myself, others, and the social norms of the community where I lived to understand and share each other's practice that could be more mathematically rich.

My Early Days of Schooling: Feeling Disconnected

I started my formal education when I was five years old, from a private school near my home. I was so happy to join the school because I got the opportunity to interact with teachers and make new friends. The skills I learned at my home, such as communication, collaboration, etc. became helpful to interact in school. Experiencing many ups and downs, I did not know how fast I adapted in the changing world and grew in school. However, I felt as Luitel (2003) in that the school was not as beautiful as the outside, not only because of the uneven floors, old wooden benches and desks, wooden blackboards, dust of the chalk and mud, broken window, a roof with cracks, but because of the number-crammed mathematics. During my initial years of schooling, I never got an opportunity to learn mathematics through games as I mentioned above, I never experienced the way of communication which could solve the everyday mathematics problems that usually occurred in the shops and the market. I had to follow the mathematical problems given in the textbooks, remember the numbers, multiplication tables, and perform simple mathematical operations in the book itself and the exercise copy. The following short narrative depicts my experience of learning mathematics properly in my early days of schooling.

It was a day in April 2002. It was around 8:30 am. I packed my school bag, kept the books, copy, pencil, etc. and finally, got ready for school with a weight of four/five kilogram in my bag. It takes around ten-minute walk to reach school. It is my second day of grade four. Most of the time, I spent introducing myself to my new friends and new teachers. Suddenly, the bell rang. We lined up for the assembly in front of the school. After completing the assembly, all of us moved to our respective classes. Our class was nearby the staff room so we quietly took our places and started talking to each other in a whispering voice. Some of my friends were roaming around the class and some were doing homework. Suddenly, the teacher came to teach us Nepali. She was also our class teacher, so she maintained our records of every work of all the subjects, events and would frequently talk to our parents. We spent our Nepali class by reciting a poem, telling a story, etc. However, the teacher told us to write one page of handwriting related to Nepali literature. In the first period, we enjoyed a lot. Our second period was mathematics. As per the teacher's instructions the day before, everybody was getting ready with a book and exercise book as well as a pencil, eraser, and sharpener. The teacher came with a mathematics book in his one hand and few pieces of chalk, a stick and a duster in his next hand. He would be happy to see the mathematics

textbooks on the table in front of each student. Some of us were still searching for something in the bag. He was angry because we three did not have mathematics textbooks. Unfortunately, we forgot the mathematics book at home. Because of this, we were punished and kept outside the classroom.

Now I have come to realize that teachers' perceptions of the textbook as the mathematics curriculum continue to encourage the splitting view of the value of the mathematics curriculum. In our context, teachers in general and mathematics teachers in particular still have the misconception that textbook serves as a framework that helps teachers think about what is to be taught and how it will be taught. Macintyre and Hamilton (2010) mentioned that, in some countries, reliance on a main scheme or textbook can lead to an acceptance that the scheme is the curriculum. For instance, American statistics cited by Haggarty and Pepin (2002) suggested that about 50 per cent of teachers are textbook bound (as cited in Macintyre & Hamilton, 2010). In our context, the textbook which is full of algorithmic problems, dominates the early years of schooling even today. There were very few story problems or word problems in each chapter.

Unfortunately, the given world problems were from a foreign context and were valueless for me, similar to what Mariana (2017) said about her mathematics textbooks. The mathematical world in my primary school was different from my playground and games, my traditional market, and my daily life. I felt disconnected from my society, relatives, and the activities that I used to do with my parents and relatives. It is almost the same in the present practice. The curriculum revision practices of Nepal might not serve the interest of the students as well as society. School mathematics curricula of Nepal are being updated in terms of content knowledge which is transmitted in a closed monotonous environment for many years, much like animals are trained in a circus (Shrestha, 2019). It seems to be taken as a vehicle for enhancing rote memorisation by subscribing to a narrowly convinced notion of reform as simply adding more content areas (Luitel, 2013). Besides these, I have some queries: was it impossible to prepare the worksheet instead of following the bookish problem? Was it not possible to create a story, poem, like in the Nepali class? Was it problematic to conduct the mathematical quizzes and group works? Why were the games that I played during my childhood isolated from the curriculum even though they were likely to become mathematically rich?

I experienced that, as I narrated above, the situation of most of the mathematics classes was that whatever was inside the textbook was true and needed to be followed through. So, I was used to learn mathematics by copying the questions in my exercise book from a textbook. The punishment that I got on the very second day always forced me to keep my mathematics book in my bag the whole year while going to school. I memorized numbers from zero to hundred as well as the multiplication tables up to 12 clearly. I did not experience using any kind of concrete materials such as base ten blocks, Cuisenaire rods, tangram or any other local materials to learn about the numbers as well as geometrical shapes. It seemed that the classroom was totally guided by the technical interest as discussed by Habermas (1992). The purpose of the technical interest is to reproduce the law-like patterns of mathematical knowledge focusing on memorizing facts and formulas (Pant, 2019). The role of the teacher is like a technician who focuses on control and manages the environment to focus exclusively on transmission as well as to reproduce approach in mathematics teaching as vital facts. But I remember the marbles that I used to play at home, which were useful for developing the concept of multiplication, addition, division, and subtraction.

This is how I completed around six months of grade four from a private school. Because of political instability, the private schools were closed. Thus, I got enrolled in grade four in a government school which was nearer my house than my previous school. The number of students in a government school was more than in the private school. The

infrastructures were better in private schools than in the government school. The mathematics teacher in the government school was from the same village and used to talk in the Nepali language, whereas the private school's teacher was from Darjeeling and used to speak in English. Besides those differences that I experienced in the very first stage of my schooling, the way of mathematics teachers entering the classroom was almost the same. Also, the teacher would come up with a mathematics textbook and a bamboo stick. The purpose of teaching looked like depositing the facts in our mind from a book that is similar to the 'banking' concept of pedagogy as discussed by Freire (1993). Thus, the curriculum seemed like a collection of content or subject matter (Schubert, 1986) guided by the technical interest.

After completing my primary education, I got enrolled in grade six at the same school. Initially, I was amazed to see the number of students in grade six. There were almost 70 students who were about 5 times more than those in grade five. Actually, there were nine wards in my Village Development Committee (VDC), one primary school in each ward and there was only one secondary school. Only one secondary school served all the students who completed primary education from nine primary schools. I became happy to see many students because I thought the mathematics teacher might not be able to check or it would be difficult for him or her to identify the students who did not bring the mathematics textbook. We might save ourselves from the punishment like in my previous grades. While I was at the end of the lower secondary level that was in grade eight, I was forced to practice more mathematical routine problems. In grade six and grade seven, I had just one mathematics textbook to practice, but in grade eight I had more curriculum materials to practice, such as a guidebook, guess paper, and textbooks of different authors and publications. I came to realize that the importance of the contents and subject matter given in the textbook increased as I got upgraded in the higher grades. Parents, teachers, and everybody was worried about the District Level Examination (DLE), which was taken in grade eight, for which question paper was brought from the district headquarters. My teacher and my relatives who experienced DLE told me that the question would not be asked from outside the 'exercise' and 'example' so that I was forced to practise the readymade routine problems, and memorize the formulas and theorems. The adage 'practice makes a man perfect' was embedded in thinking and actions, thereby giving rise to the idea that mathematical knowledge can be achieved best through blind practice (Luitel & Pant, 2019) and this belief system is still dominant in our society. I frequently revisited the table of contents and syllabus and kept on practising accordingly. In such a way, I completed grade eight and nine. In grade ten, the teacher used to give more emphasis on the textbook and oriented me to solve the mathematical problems from the textbook as much as other resources related to the textbook, such as 'guess paper', 'solution set', 'guidebook', etc. One of the reasons to promote the value of a textbook was the School Leaving Certificate (SLC) exam. They used to say: *All the questions of mathematics in the exam are asked from the mathematics textbooks, solution sets, and question banks. So your score in mathematics depends on your blind practice to solve the mathematical problems from those sources.*

Implications

My research suggests that being critical is not synonymous with being negative. Rather, critically reflective teachers, teacher educators, academic researchers, as well as education policymakers are committed to democratic principles of equality, equity, and justice (Tutak, Bondy, & Adams, 2011). In this scenario, transformative learning involves critical reflection of assumptions, status quo or taken-for-granted ideas that may occur either in group interaction or independently (Mezirow, 2003). It requires for teachers, teacher educator as well as education policymakers to participate in critical reflection on their own practices

aiming to improve themselves, which is one of the purposes of transformative education research like this. The key elements for critical dialogue are having an open mind and listening empathically with genuine respect for the perspective of the others (Brown, 2013), whereas critical self-reflection may involve observation and evaluation of own practices, including asking critical question ourselves, challenging the status quo as well as taken-for-granted ideas aiming to improve ourselves and other practices. Van Manen (1997) identifies three levels of reflection - technical, practical and critical (as cited in Liu, 2013). Knowledge construction guided by the practical as well as emancipatory interest may enable teachers, academic researchers, teacher educators and education policymakers to know their own practices, thereby motivating towards meaning-making, and understanding through questioning towards existing practices, status quo, and taken-for-granted ideas.

Furthermore, a teacher educator needs to bring teachers in critical discourses rather than simply delivering the ideas. As mentioned by Hua (2015), teacher education is historical-hermeneutic science, which takes teacher education back to its histories, traditions, and practices aiming at understanding and interpreting practices. Thus, teacher educators need to think beyond the positivist epistemology and should plan to nurture teachers' ability to improve their practices through critical research or inquiry. In addition to this, practical interest cannot ensure human freedom because it lacks critical consciousness through self-reflection (Hua, 2013). Therefore, teachers or teacher educators need to enhance critical literacy which enables them to engage themselves in questioning such as: why am I a teacher or teacher educator? What can I mean to be a teacher or teacher educator? This might lead teachers as well as teacher educators to become transformative learners.

Closing Remarks

Indeed, the journey I covered during my research was meaningful and effectual in terms of realizing empowering (i.e., meaningful, inclusive, and culturally contextualised) learning and teaching approaches in mathematics. Also, I believe that reflection on my experiences may become insightful to other researchers who have been carrying out similar studies in their fields. Furthermore, critical self-reflection on my childhood and my teenage years enabled me to realize the role of the family and the community in my decision making. Indeed, the role of the family is very important to develop a transformative learner. However, as a teacher-researcher, this reflective paper enabled me to understand the dominant structural and hidden forces of the society governing the nature of formal teaching. In addition, reflecting upon the issues on pedagogy and curriculum helped me to envisage alternative approaches in mathematics teaching and curriculum development in Nepal. At this point, I argue that one of the important factors is to emancipate every student, teacher, and school from the rigidity of a top-down centralized system, which would help to break the present hegemonic way of developing mathematics curriculum.

As a teacher, researcher and educator working towards creating transformative educational processes, this reflective article enabled me to question myself in terms of how I can work to solve the issues related to the technical interest-driven mathematics curriculum, pedagogy, assessment, thereby transforming the landscape of mathematics education for meaningful and engaged learning. I came to realize that we always need to remember the everyday mathematical practices, and communication to make mathematics classroom more effective and contextual. It is necessary to incorporate those practices into the mathematics curriculum instead of adding routine problems in the name of curriculum revision.

Acknowledgements

I would like to thank all the reviewers of my paper. It would not have been possible to bring the paper in this form without their valuable comments and suggestions. Moreover, my sincere thanks go to the language editor who spent significant time and put efforts to avoid language error(s). Last but not least, thanks go to all who always encouraged and empowered me to be involved in academia.

Funding

There is no funding from any source for this work.

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Suggested Citation:

Luitel, L. (2020). Moments of critical self-reflection of a transformative mathematics teacher. *Journal of Transformative Praxis, 1*(1), 50-60.

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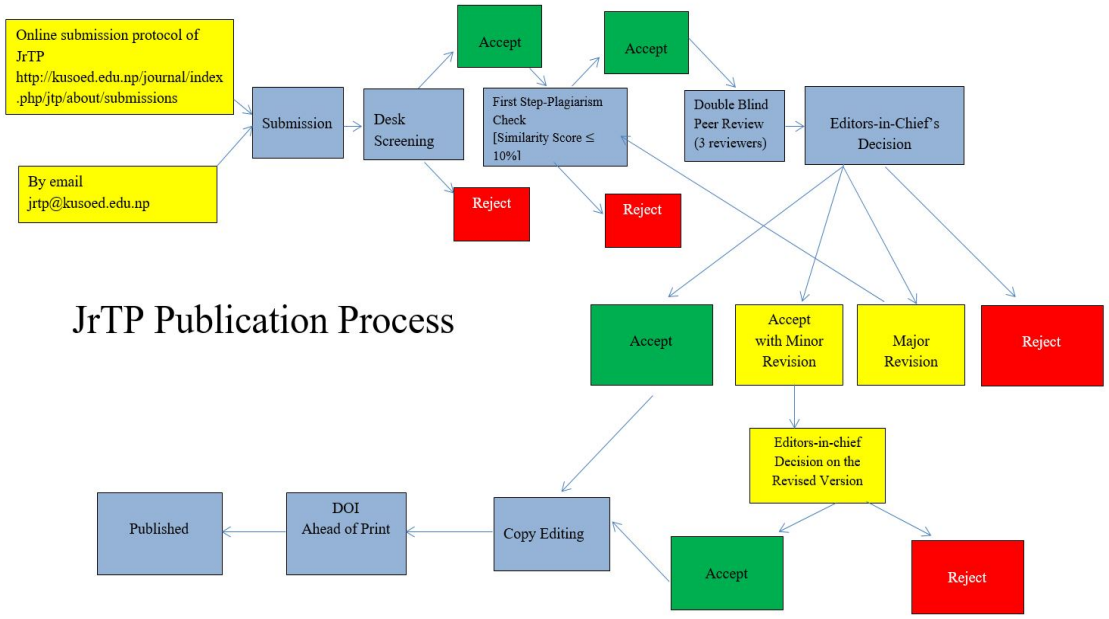

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An edited book

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Corporate author

Department of Education. (2004). *School level educational statistics of Nepal: Flash report I 2004*. Kathmandu, Nepal: Author.

An article from a print journal or magazine

Koirala-Azad, S. (2008). Unravelling our realities: Nepali students as researchers and activists. *Asia Pacific Journal of Education, 28*(3), 251-263. https://doi.org/10.1080/02188790802270245

An article from an online source

Onta, P. (2000). *Nepal education: Finding a ray of hope*. http://www.epw.org.in/35-47/comm6.htm#top

An unpublished thesis/dissertation

Gnawali, L. (2001). *Investigating teacher practices: A proposal for teacher development of secondary school teachers of English in Nepal* (Unpublished Masters dissertation). University of Exeter, Devon, England.

Non-English book

Gautam, B., Adhikari, J., & Basnet, P. (Eds.). (2004). *Nepalma garibikobahas* [Poverty debates in Nepal]. Martin Chautari.

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Bourdieu, P., & Passeron, J. C. (1990). *Reproduction in education, society and culture* (2nd ed.) (R. Nice, Trans.). Sage. (Original work published 1970)

In text: (Bourdieu & Passeron, 1970/1990).

Encyclopedia article

Bergman, P. G. (1993). Relativity. In *The new encyclopedia Britannica* (Vol. 26, pp. 501-508). Encyclopedia Britannica.

Multiple authors (up to twenty [include all the authors])

Festinger, L., Cramer, C. J., Riecken, H., Boyd, E. C., Cohen, E. G., Gill, T. G., & Schachter, S. (1956). *When prophecy fails.* Minneapolis, MN: University of Minnesota Press.

Twenty-one or more authors

Roeder, K., Howard, J., Fulton, L., Lochhead, M., Craig, K., Peterson, R., ... Boyd, E. C. (1967). *Nerve cells and insect behavior.* Harvard University Press.

Magazine article

Sherchan, R., &Sherchan, B. (2002, 30 May-14 June). Gaun-gaunmaibannathalyo mineral water [Mineral water now is produced in villages]. *Himal*, p. 21.

Newspaper Article

Prashrit, M. N. (2002, July 12). Bhanubhaktakosirjana ra rashtriyaekikaran [The creation of Bhanubhakta and national unification]. *Kantipur*, p. 5.

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- ✓ School health education
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- ✓ Critical place inquiry, indigenous, de-colonial and postcolonial research methodologies in health and education
- ✓ Research as praxis
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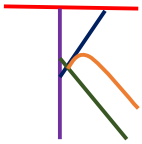

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Kathmandu University School of Education
Hattiban, Lalitpur, Nepal
ISSN: 2717-508 (Print); 2738-9529 (Online)
Email: jrtp@kusoed.edu.np
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