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Original Article

Enhancing Critical Reflective Practice in Science Education Through a STEAM Approach

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Abstract

This article aimed to explore teachers' beliefs on reflective practice in their professional life and envision perspectives for transforming their practice. I used auto/ethnography as a research methodology for critically reflecting on the self and others' lived experiences of teaching science, mathematics, and technology in the context of Nepal. I explored that reflective practice is required for understanding and transforming our deep-seated dominant cultural practices. On becoming a critically reflective practitioners, we can incorporate a trans-disciplinary STEAM approach while designing and implementing a curriculum, pedagogy, and assessment system that helps understand learners' sociocultural backgrounds, beliefs, values, assumptions, and feelings for authentic, inclusive, and meaningful learning.

Keywords: Reflective Practice. Critical Reflection. STEAM Approach. Transformative Learning.

Background of the Study

From my lived experiences, the educational practice in Nepal has made several appreciable changes compared to the past, but still, many things have remained the same. They include a classroom setting with a board at the front and chairs at the back, and most teacher educators follow the teacher-centric teaching-learning pedagogy. This teaching approach was fine in the past because people thought reading was essential to learning. But with the progressing time, the thinking and expectation of society have also changed dramatically. In this 21st century, just transmitting disciplinary knowledge, skills and ideology is insufficient for a good life. As human beings, we need to be socially responsible citizens to better society.

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Moreover, we prepare the citizens for the future, so their present learning greatly influences their future lives. Just *doing things just as done* is insufficient for developing their higher abilities (such as communication, collaboration, creativity, and critical thinking). Thus, as a teacher educator, I have realized that we need to critically reflect on our current professional practice for creating multiple futures.

Generally, reflective practice refers to studying our teaching practice and identifying the more appropriate ideas that work best for the learners. In critical reflective practice, teachers can adopt the theory until it accurately describes the practice. Typically, we can compare our teaching against our own experience and knowledge of educational theory that assumes what might occur. It underpins identifying the gap between theory and practice, so the teacher emphasizes questioning why we do something instead of how (Kuit et al., 2001). Likewise, the proper integration of critical inquiry and self-reflection is essential for becoming a critically reflective teacher. Critical inquiry is the conscious consideration of moral and ethical implications and influences of practice on learners, and self-reflection is the deep examination of personal values and core beliefs encompassed in the educators' assumptions and expectations for the learners (Larrivee, 2000). Likewise, STEAM education emphasizes art-based trans-disciplinary knowledge construction for transformative learning. It critically reflects on the self for solving real-world problems. The arts in STEAM education have a significant role in developing the interconnectedness required for authentic, inclusive, and meaningful learning. Trans-disciplinary STEAM education supports for sustainable development to be successful (Taylor, 2018). Thus, the main focus of this study focus was to understand the beliefs, culture, and perceptions of trans-disciplinary teachers like science, technology, and mathematics professionals about the reflective and critical reflective practice by reflecting on their lived experiences. I have included the background of the study, research purpose, research questions, empirical and theoretical review, methodology, narrative generation and meaning-making, implication and conclusion, and insights in addressing my research agenda.

This article aims to explore the beliefs of teachers on reflective practice in their professional life and envision the perspectives for transforming their practice. To meet the purpose, we developed the research question: - What beliefs do my research participants and I hold about reflective practice in our professional life? And how can such beliefs be un/helpful to address our professional problems?

Empirical and Theoretical Review

The Western-modern educational ideologies initiate manifold challenges and dilemmas and ruin our rural or indigenous identities because we accept our schooling agendas without being critical (Wagle et al., 2019). Critical reflection (includes reflection, dialogue, and collaborations) can be incorporated within a teaching profession for professional development and best teaching practice. Educators can self-assess their teaching cultures themselves (Akella et al., 2021). In becoming a transformative teacher, questioning the broadly trusted assumptions, and examining the deep-seated beliefs can play a significant role, so we need to examine our beliefs and practices in teaching mathematics. After being aware of our teaching constraints and context, we can envisage the appropriate alternatives for addressing our problems. We question the broadly trusted assumptions and examine the deep-seated beliefs and practices in teaching mathematics (Pant, 2017). Therefore, I tried to explore the beliefs of STEM teachers on reflective practice.

Transformative Activist Stance

Stetsenko's (2017) Transformative Activist Stance (TAS) encourages overcoming the recent compartmentalization within sociocultural approaches by restructuring a broad dialectical view of human development. It gives more emphasis on the relational worldview than a transactional process, so it catalyzes the continuous dialogue and participation, relatedness and interconnectedness, and the coming together of individuals and their world. It emphasizes collaborative and unified transformative ontological praxis rather than continual efforts to make things happen. That is, it counters the product-oriented, routinely based teaching culture. It believes that the mind is a dynamic system, so people have an estimate of reality through knowing, being, and doing in the process. They reflect on the history of the entire system, not just the immediate conditions. Through self-reflection, individuals can understand and actualize their relation to the world and other people.

TAS advocates that the ethical dimensions of development are required in science education for developing political imagination, relativism of knowledge, commitment, and visions. Further, it acknowledges divergences and differences based on the non-instrumentalizing connection where the simultaneous process of transforming and being transformed by the other takes place. However, people emphasize adaptation, which is a profoundly Darwinian view that the goal of development is to adapt and fit in the world as it is. To remove to grasp universal laws and uniformity, the present ideas of science need to hold variation and change. For unfolding the concept of human development, we need to move towards the unified, inclusive, and transformative worldview (knowing, being, and doing) that can develop holistic thinking and socially responsible science education. Therefore, I have applied TAS as a referent for this study.

Methodology

The research methodology was an auto/ ethnographic research inquiry. There is a dialectical relationship between autobiography and ethnography (Luitel & Taylor, 2019). It has a significant role in transforming the researchers' misconceptions, taking for granted assumptions and habits of non-reflective thinking and behavior in their everyday practices for altering our way of being in the world. To explore self and beyond to experience transformative learning, this research method provides new ways of seeing, feeling, observing, knowing, expressing, and re/presenting. It brings a paradigm shift in thinking, beliefs, and perspectives and advocates for emancipation by developing capacities and awareness at personal and societal levels, supporting the fight against inequalities embedded in societies (Qutoshi, 2015). Auto/ethnography as a transformative research paradigm promotes the incorporation of multiparadigmatic (i.e., constructivist, interpretivist, critical, and postmodernist) design space, which provides enough space and flexibility for moving towards holism. The researcher can incorporate these multiparadigmatic lenses in studying the self, exploring and reflecting on the self, and meaning-making process (Luitel, 2012). My research proposes, and questions are closely related to the notion of this methodology. For this reason, I have incorporated this methodology into my research journey.

My research participants were my two classmates in STEAM education, three school-level science teachers, and me. I have selected my research participants purposively as per my convenience. My research participants have been working in different places in Nepal. Narratives were generated through self-reflection, critical interviews. In that process, I also used narratives and metaphorical logic for representing happiness, sadness, sorrow, and epiphanies in their teaching-learning journey. The narrative genre evoked us to think about issues and events through multiple dimensions (Luitel & Taylor, 2019). To reflect on me and

my participants' deep-seated cultures, beliefs, and perspectives, I have followed the writing inquiry process (Richardson, 1994) that helps make my narrative generation and meaning-making process more authentic.

Narrative Generation and Meaning Making

In this study, I have generated various narratives of my own and my participants and developed the meaning for seeking the beliefs of STEM teachers on reflective practice. I have mentioned my and my participants' stories webbing around the critical reflective practice.

STEM Teacher's Beliefs on Reflective Practice

I emphasized excavating the beliefs of STEM teachers on reflective practice in their professional life and envisioned the perspectives for transforming their practice. In doing so, I have deeply engaged in narrative generation and the meaning-making process. After critically reflecting on my and my research participants' narratives, I realized that mundane thinking changing, closed box breaking, conception-changing, home visiting, multifaceted science teaching-learning, and interactive science teaching are the key themes for representing their whole story. Therefore, I have used these themes as the heading of each narrative to make these narratives catchier and more enthusiastic.

My Mundane Thinking Changing Story

At present, I have been working as a science teacher educator. Before my STEAM learning journey, I prioritized the science discipline (especially chemistry) knowledge, skills, and philosophical indoctrination. While teaching chemistry education, I am less able to connect that idea with other disciplines such as mathematics, engineering, and technology, contextualizing the concept by understanding the learners' frame of reference (Mezirow, 1996) and developing them as critical and holistic thinkers. I have engaged my learners less in critical discourse toward specific definitions, postulates, principles, views, and perspectives. I have incorporated more teacher-centric pedagogy, which is less helpful for enhancing the learners' creativity. That is, a *sit-and-get* environment was dominant in my professional practice.

While teaching science, I have taught different science learning theories, approaches, and different teaching pedagogies. But I was less conscious of incorporating them into my real classes. I needed to deliver theoretical knowledge to my learners to secure good marks in exams rather than change my practice to turn me and my learners into agents for transforming others. Instead of changing the learners' deeply rooted beliefs, feelings, and cultures, my teaching-learning processes acknowledged the knowledge transmission process. In my STEAM educational learning journey, I realized that learners' epistemological change is insufficient for transformative learning; therefore, we need to reveal and re-conceptualize our ideality (Yusuf et al., 2017) for bringing ontological change.

Further, I experienced that the dominant teaching culture is un/knowingly embedded and seems to be normal and natural. So, in becoming transformative teachers, we need to excavate the hidden disempowering elements embedded in our professional culture. As a transformative-minded STEAM learner, I have come to realize that critical reflection is an appropriate way for shifting our deep-seated values, beliefs, cultures, and assumptions,

I have tried to change my more teacher-centric science teaching practice. Although my present practice is insufficient to change the learners' concept, to create full reciprocity-based science learning, where all my learners will be free from all types of constrain (such as time or content to care), coercion (bullying), and representing their undistorted self (true self)

(Habermas, 1972), I acknowledge group discussion, collaboration, and also scaffold the learners whenever they have misconceptions (alternative conception) or they feel difficulties. Recently, I have thought about the positive influence of STEAM education in my professional practice. I want to share the STEAM approach-based designing thinking project - "Let's Make Our Favourite Soap at Home," that I launched at the bachelor's level. Developing entrepreneurship skills by understanding the conceptual, theoretical knowledge, and practical skills about soap was that project's objective. In the project implementation process, students actively reflected on their lived experiences, defined the problems, explored the proper solution, and designed, tested, and presented the project in a classroom. They shared their feelings, experience, and knowledge artistically. I also critically observed their participation, asked critical questions, and played a role as an optimal scaffolder. I perceived my stronger and weaker parts by critically reflecting on my professional practice from different vantage points and got an opportunity to transform my thinking and actions. Therefore, I am aligned with the STEAM approach and critical reflective practice in science education for shifting our instrumental knowing-based science teaching culture towards more authentic, inclusive, and meaningful learning.

I have reflected on my professional practice in my mundane thinking changing story by dividing my experiences into two parts. I reflected on professional practice before my STEAM educational journey in the first part. The one-size-fits-all pedagogy largely guided me; I was less conscious of critical reflective practice. Hence, I essentially implied the routine or mundane-based pedagogy. Although learners were less engaged in my classroom, I continued my classes and completed the recommended courses. That means I focused on '*do things as done*'. For that reason, in my understanding, my teaching was guided by Habermas's (1972) technical interest.

On the other hand, I reflected on my professional practice after my STEAM education in the second part. In my present practice, I have encouraged my learners to ask questions, discuss, STEAM approach-based designing thinking activities and also tried to reflect on my practice because I have realized the need for transformative pedagogy in science education that supports raising questions about our practices by establishing a dialogical relationship between teachers and students which helps for individual and social transformation. It can engage both teachers and students in critical reflective practice and bridge the gap between theory and practice (Shrestha et al., 2020), which is required to change the deep-seated belief system in my practice. However, my current practice is insufficient to change the learners' ontology. In my understanding, if we change our dominant teaching culture and develop ourselves as an agent, we can change others (such as learners, co-workers, and institutions) and make us more socially responsible practitioners. Therefore, I realized a need to shift my professional culture towards transformative learning.

Photon's Closed Box Breaking Story

My name is Photon Thapa. I have been working as an educator for ten years. Before my STEAM educational journey (approximately one year ago), I did not know reflective practice, so I had no idea how it could be helpful in my mathematics classroom. How could I connect it to my profession? The teacher-centric teaching culture largely guided me. While teaching statistics in bachelor's level engineering classes, first, I made the pin-drop silent and started to deliver my classes. I thought that I was perfect in my subject matter; the learners should listen to me and copy my ideas. This dominant ideology guided me. For instance, I thought that I was a superior person in the class. "*I have taught this content for ten years, so there is no confusion and no chance of making mistakes in my teaching process,*" I believed. I used to ask questions about the content that I had taught in my classroom, and I also checked the exam paper

accordingly. I felt it was unnecessary to connect my teaching-learning process with lived experiences and other real-world problems. That means my thinking and practices were run in an autocratic manner. I was unable to counteract the unhelpful egos. And I was guided by disciplinary egocentrism (Connor et al., 2015); I thought nobody could deliver the lesson better than me, i.e., I developed subject-based identities (Beane, 1995).

In my past classes, especially intelligent and medium-level students raised questions, and the so-called weak students mainly were silent over the period. Although some students also critiqued my practices, I largely neglected their multiple voices and conducted the classes as per my interest. I felt much difficulty sharing my problems and weaknesses with others, so I tried to hide my weaker parts. However, in my present STEAM educational journey, I have learned that several confusions and difficulties in our educational practice can be resolved through collaboration, cooperation, and a critically reflective process. Therefore, we need to represent our undistorted selves (Habermas, 1972). If we hide our weaknesses, it may be unhelpful for my learners and me.

My learners and I have been trying to shift toward critical reflective practice in my recent classes. We have realized that it is supportive of detaching or breaking my disciplinary egocentric ideology and practice to some extent. In other words, I am on the journey of breaking the closed box because I have found that a controlled learning environment is less helpful than a democratic learning environment. It is guided by the technical interest (Habermas, 1972) that is inadequate for inclusive learning. However, I am less able to radically change my traditional teaching culture because there are different constraints (such as time, and references) and curriculum guidelines that are essential to follow. For improving and transforming my professional practice, I will be deeply engaged in this critical reflective practice in the following days.

From my present learning and professional practice, I have felt that we are still less able to develop critical reflective learners due to our dominating cultural practice such as curriculum design, instructional delivery, and assessment design. Although my present STEAM educational learning has given me a positive insight for changing my dominant ideology, I can still not fully apply it in my actual practice. In my understanding, arts in STEAM have a significant role in fostering critical reflective practice and transforming our dominating teaching culture towards authentic, inclusive, and meaningful learning. So, we need to deeply understand the role of arts and incorporate them into our education. Consequently, it can help to create a dialogic space and reduce disciplinary egocentrism.

In Photon's closed box-breaking narratives, I have found several ups and downs in his professional journey. Primarily, he was guided by disciplinary egocentrism, so he focused on pure mathematics (theoretical knowledge) and instrumental understanding. That means he fostered stimulus-response chain-based operant conditional learning (Taylor, 2014). Although the learners may have so many lived experiences, knowledge, and creativity, he could not understand the learners' interests and launched his mathematics classes with his interest. That played the role of *subject specialist*. However, his STEAM educational learning journey largely supports breaking or detaching his dominant ideology and professional practice. He has been trying to shift from informing pedagogy to reforming and STEAM-based transforming pedagogy, largely related to Habermas's (1972) practical and emancipatory interest because he has tried to change the dominant ideology, which seems to be to be normal and natural (Habermas, 1987). That is why he has focused on understanding the learners' interests, and lived experiences, and encouragement to raise questions. Furthermore, he has been trying to be a generalist by applying different art-based pedagogies in his critical reflective practice. He has realized that critical reflective practice is necessary to introduce into our curriculum so that we can easily integrate it into our practice and can create multiple futures.

Anode's Conception-changing Story

My Name is Anode Khatri. I have taught in many schools and colleges in Kathmandu Valley for twelve years. Meanwhile, I have also engaged in my STEAM educational journey and learned about different transformative teaching-learning pedagogies such as project-based learning, problem-based learning, and critical reflective practice. In such a context, STEAM education largely supports improving my instructional delivery practice. For instance, I have been incorporating the program-based learning pedagogy while teaching programming parts of my course. In this process, I first divide the students into small groups, and then I provide the necessary guidelines. After that, the students engage in problem-solving activities. While reflecting on my learners' activities, I have identified the positive influence of my recent practice because they ask questions, interact in their group, and demonstrate their learning progress.

In my STEAM learning process, I have found that critical reflective practice has a significant role in transforming our professional practice. We can critically assess our practice by applying self-reflective and critical questioning (Brookfield, 2015). Furthermore, teachers and students can understand their lived experiences, and synthesize the different information, feedback, logic, and reasons for solving problems differently (Larrivee, 2000). Critical reflective learning is the foundation for authentic learning. It helps to resolve real-world problems. Therefore, in the teaching-learning process, all the learners need to be aware of it in their learning journey.

It was an event twelve years ago. I was the youngest teacher in that school. When I entered the classroom, all the students were silent and strongly obeyed my instructions. At that time, I was also guided by the dominant ideology, so I thought that students should strictly follow my instruction in my classroom. For instance, according to my guidelines, they should have reading and writing activities. I tried to control my classroom milieu. Meanwhile, one of my students crossed the border that I had already planned. He had gone against my learning environment, so I punished him and gave him a warning to do the activities as per my instruction in the upcoming days.

After the event, I came back home, but the event made me more thoughtful. I tried to sleep, but I could not. It disturbed my sound sleep. I critically reflected on that incident from different angles. I realized my weakness and apologized to his parents the next day. From that event, I became flexible in my teaching culture. That means this critical incident was also helpful in improving my practice and changing my conception to some extent. Similarly, I also learned different knowledge and skills by collaborating with my colleagues and co-workers to enhance my professional practice. It is more helpful for conducting my regular classes and fostering my learners' creativity.

In Anode's conception-changing story, as a teacher, he has largely practiced project-based learning while teaching programming parts of his course. He has realized that his present STEAM educational learning journey is the foundation for changing his conception of teaching-learning. His past teaching-learning was guided by Habermas's (1972) technical interest that emphasizes the controlled learning environment and empirical knowing. Hence, the critical reflective practice that he has learned in his recent classes is beneficial for fostering the learner's creativity and improving his professional practice. In his past educational journey, he had followed the reflective practice to some extent, which was very helpful for improving his practice. However, he has gained different theoretical and practical knowledge and skills in critical reflective practice in his present learning journey. Recently, he has applied self-reflective and critical inquiry (Larivee, 2000) in his profession. In his STEAM educational learning journey, he changed his frame of reference (Meziro, 1996) and tried to incorporate

those ideas into his classroom practice. However, he has still faced challenges connecting the content with real-world problems.

Crystals' Home Visiting Story

My name is Crystal Joshi. I have been teaching in different schools for 25 years. I have collected different lived experiences in my teaching and learning journey. After completing my intermediate level, I started my teaching profession. From my teaching-learning experiences, I have realized that learning is not an effortless task because different components, such as learning environment, family background, and socio-culture, influence the teaching-learning process. So, if we have good interaction or connection between these fundamental components, we can address the needs and interests of the students and society. I have worked in different cultural communities and collected different lived experiences in my teaching-learning journey.

I want to share some critical incidents that made me more aware of my learners, learning environment, and professional practice. When I was teaching at a Lower Secondary School in the Gorkha district in 1995, I was the youngest teacher in that school with no lived teaching experience. I had insufficient knowledge about the sociocultural background of my students. Hence, I was less able to address the learners' needs. Most of the learners were from the 'Kumal' and 'Newar' communities. They were less interested in interacting with the teacher. They were shy or hesitant to answer the questions due to language. I mean, they felt it difficult to speak the Nepali language. Most of the students would not eat any food till midday so the students would be hungry during the teaching-learning time. It felt very difficult for them to concentrate on the teaching-learning process.

For addressing the learners' needs, the school managed the break time. During that break time, they would go to their home, have a meal, and come back to school. Then we would continue our regular class. In my critical analysis, the sociocultural background largely influenced the learners' participation (Vygotsky, 1978). They largely thought about the food rather than teaching-learning activities. I also tried to understand their problem and encouraged them to participate in an interactive activity. However, I could not connect science education with their everyday life. If I had deeply studied the learners' interests and contemporary society, I could have enhanced the learners' engagement.

As a secondary-level science teacher, I have been working in the Chitwan district since 2015. I have collected several better experiences in my present professional journey. The headteacher, School Management Committee, teacher, and society are very much engaged in improving the school's learning environment. While reflecting on my past twenty years of science teaching-learning experiences, I have found my present lived experience more satisfactory because the school's learning environment is very good, and parents are very conscious. The school has launched the program in English and Nepali; there are two teachers in secondary-level science education. We collaborate, share our problems and feelings, and try to solve our professional problems. Likewise, I also collaborate with health and social teachers to elaborate on some related concepts. In leisure time, all teachers gather and discuss the learning progress and other academic activities such as curriculum, lesson plan, teaching materials, and question design.

I have used ICT and different arts in my everyday professional practice. My present school environment makes me a more active practitioner. Comparing it with my past journey, I have spent more time on classroom preparation. I have learned several ideas from my present practice. I have found that learners' sociocultural background is a powerful part of education in my teaching profession. Without understanding the learners' family backgrounds and cultural backgrounds, we cannot imagine a good teaching-learning. Hence, in my science

teaching-learning journey, I have visited my learner's *door-to-door* to understand their family backgrounds and convinced them by interacting with their parents. I have realized the positive influence of home visiting activities on learners' progress. I recently realized that I could improve my weakness in the following days.

From Crystal's home visiting story, I have felt that teaching and learning are continuous processes. Although he could not define the literal meaning of critical reflective practice, he reflected on the different lived experiences in his teaching and learning journey. He realized different problems while working at different times, places, societies, and cultures. And he tried to address the problems by understanding the learners' sociocultural context. He also visited the learners' homes and tried to understand their parents' views and culture. Likewise, he envisaged everyday life-related education, schools' learning environment, an active society, and a collaborative teaching-learning environment for improving our science educational practice. In his initial practice, he was guided by the dominating teaching culture that the metaphor of communication can represent *as war* (Lakoff & Johnson, 1980). However, he has now realized his weakness and has tried to improve his professional practice. Thus, he has spent more time in his teaching preparation and applied the different arts, ICT, and other teaching materials for making his classes more interactive. Hence, in my understanding, he had followed analytical, reflective practice in his past teaching-learning journey. However, in recent years, he has been becoming a critically reflective practitioner (Brookfield, 1995).

Sumi's Multifaceted Science Teaching-learning Story

I am Sumi Shrestha. I have been working as a secondary-level science teacher since 2014 in the Gorkha district. I want to reflect on some of my science teaching-learning-related lived experiences. The teacher-educator largely focused on instrumental understanding rather than relational understanding in my science learning. Meanwhile, I asked, "Sir! How can I apply it in our life?" the teacher replied, "I also recalled this content to go for obtaining a good score in the exam, so memorizing the context is enough. We do not require it to learn out of our syllabus". However, recently I have felt that my past learning experiences have had a greater influence on my present professional life.

I am also less able to connect science with our everyday lives. The curriculum has emphasized rote-recall-based teaching-learning. For instance, most of the objectives of the curriculum focus on definition and differentiation rather than connecting with real-world problems. Although some lessons motivate the learners to engage in practical work, they do not foster their creativity. Similarly, in my understanding, our present grading practice does not implement the real notion of a letter grading system. I have also realized that this system is misinterpreted in our context. Most learners think that they can easily pass the examination; it is unnecessary to engage in learning deeply. I have identified that such an ideology has been dominant in recent years.

Furthermore, students are less interested in my classes, and there is no science laboratory, time, and human resources in my workplace; such constraints also negatively influence my classes. I have tried to use locally available low-cost and no-cost materials in this context. However, the learners are less interested in observing these materials. Once, they said, "Madam! We have already observed that object; why do we need to observe the same thing again and again?" Such kind responses from my learners made me more thoughtful. During that time, I feel that the learners were more interested in learning science more creatively. But I am not fully able to address the learners' interests.

Most of the students are from *the Dalit* community. The students whose family background is good and whose parents are educated have a good performance in school compared to those who have single parents or no parents, and poor economic conditions. They

can easily manage the required materials for their children and are more conscious of their children's learning. They interact with teachers and headteachers and try to improve their children at home. On the other hand, those students whose families are in problems are less able to address their children's needs and less conscious of their learning progress. Hence, their performance is very weak compared to the students with good family backgrounds. I have completed a master's degree in science education, majoring in chemistry. However, at the secondary level, it is compulsory to teach other disciplines of science education, such as physics, biology, and astronomy, so; I have faced problems while teaching theoretical and practical parts of these disciplines. Hence, from my lived experiences, I have realized that if we had managed separate disciplinary science teachers, we could have addressed the present teaching-learning problems. This is because we can share our interdisciplinary problems. Likewise, I realize a need for collaboration with trans-disciplinary teachers who can help to improve our classroom performance.

However, most teachers largely focus on the subject matter to achieve excellent results in the present practice. The present result-oriented teaching-learning practice has put mental pressure on both the students and teachers because the identity of teachers, learners, and schools is defined by their annual results rather than by learners' creativity. Likewise, the teachers and supervisors also develop their identities based on subject-matter lines (King, 1976), which is not good. For highlighting the schools' or teachers' names and fame, we largely force our learners into memory-based activities. Hence, I am unable to create a collaborative learning environment.

Similarly, I am also not able to connect my teaching-learning with our real life. In my physics classes, I have taught different definitions and numerical problems of acceleration and velocity. Still, I have no logical concept of how I could apply it in our everyday lives. In my understanding, it has happened because my science learning culture largely guided me. If my teacher had connected science education with our social context, I could have been able to apply that practice easily. Thus, my past science learning journey directly or indirectly promoted my dominant science teaching culture as a cultural reproduction (Schubert, 1986). For instance, while teaching about gases, and different chemical reactions, my students feel very difficult to understand the phenomena and write the chemical reactions. Due to the lack of a laboratory, I cannot conduct practical work and do not have proper ideas for clearly interpreting that content and connecting it with our everyday lives. In my past learning journey, I also faced the same problems, and I am still unable to address these problems completely.

In Sumi's multifaceted science teaching-learning narratives, she has largely been unsatisfied with her science teaching and learning. In her learning journey, she was less able to connect the different scientific concepts with the real world because her teaching-learning process was largely guided by instrumental understanding to secure an excellent exam result. So, arriving at this stage, she has realized that her past learning culture has largely influenced her present professional practice. That means she is also guided by the dominating notion based on teaching culture and is less able to connect science teaching-learning with the learners' authentic life. Through her lived experiences, she has identified the problems in different aspects (such as curriculum, learning environment, learners' family background, and evaluating systems) of our educational system. Thus, she has also deeply understood these aspects of the curriculum designing and implementation process. Hence, learners can connect science education to their everyday life. Likewise, she highlights inter and trans-disciplinary collaboration. Dhungana et al. (2021) explored cross-professional collaboration for fostering professional agencies to integrate curriculum and professional development programs to practice student-centered pedagogy and take on leadership positions.

Consequently, it grows professional autonomy. Therefore, in my understanding, she is in the process of reforming and wants to transform her science teaching-learning. Although she

cannot completely define the literal meaning of reflective practice, she reflects on her professional practice very well. This indicates that she is not fully satisfied with her professional culture.

Diamond's Interactive Science Teaching Story

My name is Diamond Khatri. I have been working as a science teacher in the Pyuthan district since 2015. Now, I would like to reflect on some lived experiences of science learning and teaching. My initial journey of science learning was very struggling. I found a vast gap between the school level and a higher level of science education. There was no appropriate connection between the content, instructional delivery methods, language, and other learning environments. However, at my bachelor's and master's levels, I also studied different subjects such as education, curriculum, pedagogy, and psychology. These subjects were new because I had come from pure science (I. Sc.) background. I realized that science education was primarily connected with our lives at that time. I learned the different theoretical and practical knowledge and skills of science teaching-learning. For instance, I played the role of both teacher and student, and I realized the problems of both sides. That was a wonderful experience for me in my learning journey.

After completing my master's degree, I worked as a basic-level science teacher. In my teaching career, initially, I focused on identifying the prior knowledge of my learners. So, I encourage my learners to do prediction and discussion activities. In that process, I had to incorporate different arts and information and communication technologies (ICTs). There is a facility of ICT and science laboratory in my school. Thus, I can easily engage my learners in different audio-visual, practical demonstrations and interactions. I play the role of a *facilitator*, i.e., I help the learners with their difficulties and confusion (or alternative conception).

I have found that learners are more active in real-life-related content. For illustration, while teaching health-related problems (such as different diseases), and different everyday life-related scientific demonstrations (such as atmospheric pressure), they give more interest and ask their queries. Consequently, I have felt it easy to develop a relational understanding by connecting different concepts with their everyday lives (Beane, 1995). Meanwhile, I have also felt difficulties connecting the content of science education to the everyday life world. For instance, although I demonstrate the chemical reaction in chemistry, I am less able to show the internal process of a chemical reaction. They are less interested in studying the content, so I have faced challenges in my teaching-learning process. The curriculum is designed based on the academicians' interests rather than the learners' interests (Beane, 1995).

In my understanding, the teacher and students are *two sides of a coin* to create a good relationship with each other. As a teacher, I have tried to connect my science teaching with our social context, so students actively participate in my classes and ask several questions without fear. However, I am not able to connect all science content to the real-life world and develop relational understanding. In science teaching, learners ask several questions, and sometimes, I may have no clear idea about their problems. Meanwhile, I honestly say sorry, and then the next day, I study the related documents and try to make them clear. Hence, I have realized that I am in the process of learning because there are several weaknesses still embedded in my teaching process that need improvement.

From Diamond's interactive science teaching-learning story, I have felt that his science teaching-learning is more interactive. He has applied his past learning knowledge, skills, and ideas in his actual science classroom to some extent. Furthermore, he has encouraged the learners in interactive activities such as predicting, discussing, questioning, and interpreting. Moreover, he uses different ICT tools, art-based pedagogy, and a science laboratory. He believes that good relations between the teacher and learners and everyday life-related science

concepts are the foundation for creating an interactive learning environment. And he has realized that we need to identify our weaknesses through the reflective process that helps improve our practice.

Conclusion and Implication

From this auto/ethnographic research inquiry, I identified that most STEAM scholars are largely aware of the beliefs and perceptions of critical reflective practice. However, they are implementing their knowledge, skills, and ideas in their professional life. Furthermore, they have realized that they can apply critical reflective practice in their actual classroom if the curriculum is designed to incorporate this notion. Likewise, the participants beyond STEAM education did not know the literal meaning of critical reflective practice. However, they have tried to use critical reflective practice to some extent.

Moreover, most of my participants and I have learned that our past less critical learning and teaching culture has a greater role in fostering the hegemonic culture in our professional practice. Thus, recently, some participants and I have been applying arts-based pedagogy and critically reflecting on the learners' sociocultural background to connect the teaching-learning with their real world. Furthermore, we envisage the STEAM approach in designing and implementing the curriculum, pedagogy, and assessment system of STEM education for meaningful learning, which acknowledges critical reflective practice. Finally, it might be significant to the readers, science teachers, teachers-educators, and researchers.

Insights

From this study, I have learned that reflective practice is insufficient for understanding and transforming our deep-seated dominant cultural practice. The dogmatic and hegemonic culture dominates the STEM profession due to the lack of critical reflective practice. We need to understand our sociocultural backgrounds, beliefs, values, assumptions, and feelings. In becoming a critically reflective practitioner, we need to incorporate the critical reflective notion while designing and implementing curriculum, pedagogy, and assessment system. The art-based trans-disciplinary STEAM approach helps to create an open space for authentic, inclusive, and meaningful learning in science education.

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