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Original Article

Transformation is Multi-faceted Processes and Outcomes: Exploring Change through STEAM Projects

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Abstract

The disciplinary egocentrism in the school education in Nepal dominates Nepali classrooms and hampers students' holistic and problem-solving skills. The researcher implemented a STEAM project in a Nepali public school using participatory action research (PAR). Five teachers and STEAM club students planned, acted, and reflected on the research process. Stories, reflections, and memos were used as data. The project "Save the Species: I Keep Water Plates on the Roof for the Birds" allowed students to design and implement practical, creative, and ethical bird conservation solutions while learning math, science, social studies, and art. Students considered ethics, ecology, and cultural responsibility while designing bird nests and water plates. Due to course load and cultural expectations of procedural learning, teachers initially opposed the method. Throughout the research, teachers and students had transforming experiences, discovering new ways to learn beyond memorization to critical, creative, and relational levels. Findings show interrelated and multifaceted transformation aspects. First, transformation as thinking relies on cognitive restructuring and critical reflection, using unsettling dilemmas, cognitive dissonance, and authentic tasks to test assumptions. Second, transformation as an intentional attempt stresses co-researchers and the lead researcher's purposeful, continuing, and frequently uncertain change efforts. This dimension emphasizes transformation as iterative attempts, failures, and professional progress throughout time. Third, change as process emphasizes discourse, scaffolding, and knowledge co-construction over outputs and measurable successes. Next, the transformative notion is also discussed as process and product. Finally, it is discussed how the notion of transformation contributes to the sustainability of actions and learning. The study shows that STEAM may integrate disciplinary, cultural, and ethical knowledge to honor local settings and address global issues like sustainability by placing it in a participatory framework. The study explored that STEAM projects

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through PAR can promote multilayered, transformative learning. It goes beyond procedural to relational, ethical, and imaginative knowledge.

Keywords: *STEAM Projects. Transformation. Participation. PAR.*

Delving into the Inquiry

It is widely discussed that schoolteachers in Nepal usually teach different content under several subjects. The school normally assigns different teachers to teach different subjects. The curriculum appears largely aligned with the notion of *curriculum as subject matter* (Schubert, 1986) in the Nepali context. The purpose of such a notion of curriculum is to help students achieve subject-specific learning objectives and have very limited skills in dealing with real-world problems. The different subjects (e.g., English, Mathematics, and Science) are drawn from different disciplines. In doing so, the subject teacher is bound to teach the subject matter of his/her discipline. On a single day, the students have to make different journeys with teachers of different disciplinary mindsets. Such a seemingly different journey could hinder rich learning experiences among school students. Normally, the students are encouraged to memorize the information and demonstrate the limited skills to solve routine kinds of problems, thereby producing a procedural understanding of the subject matter (Baker et al., 2004). Such practices created disciplinary egocentrism in the long run. Disciplinary egocentrism is a state of thinking and performing certain tasks where a person is hegemonized with the particular disciplinary knowledge system and ways of developing such knowledge (Connor et al., 2015) among students and teachers, which generally does not allow them to think outside their disciplines. Multidisciplinary and unconventional approaches to knowledge and performance are not welcome in such a setting.

As mentioned in the National Education Framework, as indicated in the integrated curriculum (Curriculum Development Center [CDC], 2019), school education has envisaged producing creative and critical citizens who can solve real-world problems. Real-world problems require knowledge and skills from multiple disciplines. For example, if a student is asked to develop a model of a house, she/he has to use various knowledge and skills from different subject areas – designing ideas from engineering perspectives, taking the measurement of different parts, and calculating them by using mathematical knowledge and skills, using different available materials from the perspectives of contemporary society, being aware of strength and security from scientific perspectives and more than that, bringing uniqueness and creativity from the artistic perspectives. Our school education culture, which is referred to as the grammar of schooling (Tyack & Tobin, 1994), has neglected to develop such a holistic perspective, which is essential in the personal, social, and professional worlds.

Normally, before the initiation of an integrated curriculum in Nepal, I experienced that the connections among different subjects and within the content of the same subject are not well uncovered and recognized in the Nepali education system. Several pieces of literature (such as Mahmoudi et al., 2012) argue that such practices cannot promote holistic education and do not welcome multiple ways of knowing, such as cultural and ethical knowing (Taylor, 2015). In the Nepali education system, educators should focus on treating the child as a whole, addressing their social, emotional, and intellectual development. This approach emphasizes integrating concepts from different disciplines critically and creatively. STEAM education, an integrated and interdisciplinary approach to learning, might encourage teachers to think more broadly and critically about real-world problems. This approach solves real-world problems by creatively incorporating scientific, mathematical, engineering, and technological knowledge.

STEAM education has been proposed to promote productive engagement among learners in science, mathematics, and related curricular areas (English, 2016). STEAM education prioritizes an integrated curriculum and pedagogy to use knowledge and skills in creative and imaginative (i.e., artistic) ways. The 'A' in STEAM education helps address the unaccounted approaches to integration. For example, arts-based methods (fine arts, literacy arts, language arts, etc.) help teachers and students connect various science and mathematics disciplinary skills. This does not mean that every problem needs all the dimensions of STEAM education. It usually requires more than one area to explore better solutions. For that, our traditional "subject-centric" approach to teaching and learning is disempowering.

STEAM education also engages students in transformative learning by exposing them to interconnected ways of knowing, such as cultural self-knowing, relational knowing, critical knowing, visionary and ethical knowing, and knowing in action (Taylor, 2015). Cultural self-knowing aims to recognize our culturally situated selves and the shared values and beliefs that emerge in the cultural identities of our ways of being and making sense of our social and natural worlds. Working in the field of education, exploring culturally situated values of pedagogical practices, and making sense of those activities are very important for me. The relational way of knowing is also crucial as we engage with culturally different groups (such as teachers and students) in the learning process, which should be empathic and compassionate. As a teacher educator, I believe that relational knowing is one of the most effective ways of knowing. Next, I use the notion of critical knowing that allows me to understand how and why the different forms of powers (political, institutional) have influenced the social realities by creating apparently natural categories rooted in categories of class, gender, etc. The most important issue is to explore how those invisible powers influence our life worlds as teachers, teacher educators, and researchers, and our relationships with other community members. To explore better opportunities in pedagogical innovations, the visionary and ethical knowing provided me with enough space to imagine and explore better ethical alternatives (Pant, 2024). While doing so, I became aware of my position and limitations as a researcher in the public education system. When I discussed with schoolteachers and students several times during our fieldwork on what a better world could be like, and what a better school should be like, regarding STEAM-based education. Lastly, we, as co-researchers, subscribed to the idea that knowing in action, with a commitment to make a difference in the field, supported us in generating evidence-based knowledge rather than believing in so-called grand theories without implementing them in real contexts. In this context, the author conducted a Participatory Action Research (PAR) in a public school in Nepal. This paper is a part of the entire PAR research study in which I share how we collaborated to develop one STEAM project and generate the notion of transformation from different perspectives.

Crafting the Journey of the Inquiry

To serve the common interest for the improvement of pedagogical approaches to school education, the knowledge has to be established through a series of dialogue sessions with research participants, acknowledged as co-researchers, due to their active involvement in the entire research journey. As a scholar, I also believe in the participatory approach to knowledge generation. So, I chose PAR as my research methodology. The important part of PAR is that it fully integrates three elements, as it appears in its acronym: participation (i.e., life in society), action (i.e., experiences), and research (i.e., knowledge making) (Chevalier & Buckles, 2019). I also subscribed to the opportunity to act as an activist-scholar, as PAR provides such opportunities during the process. PAR is the belief that knowledge is constructed, and those participating in its investigation can transform society (Padilla, 2014).

My research site is located in the Kavre district, which is around 65 kilometers east-south of Kathmandu Valley. One of the schools is named an action school, where the actions are done at the beginning, with the collaboration of stakeholders. The other schools are named as reference schools where the success stories of the action school were carried out as reference. This paper was developed based on the collaborative effort conducted in the action school. The co-researchers for the collaborative activities were 5 teachers. The participants were students from the STEAM club. The co-researchers were involved in planning, implementing, and reflecting on the entire journey. The participants were engaged during the implementation phase only.

The entire study was conducted into three cycles in two schools. After completing the second cycle, we had reflection sessions among co-researchers. We collaboratively decided to work on the transdisciplinary nature of STEAM projects, and we named the Transformative STEAM project. This cycle also lasted for 16 months. This cycle went from August 2021 to the last month of 2022. The "data" are stories shared by my co-researchers, pain, and pleasure experienced and felt by the lead researcher and the co-researchers, and the evidence of the realizations during and after the actions by the co-researchers. For this ,the data was generated by continuous formal and informal interactions and memo writing by the lead researcher throughout the research process. At the same time, as the lead researcher, I also maintained a diary of my involvement as a university academician and teacher educator to map my engagement with different professional organizations concerning my research activities. The narrative analysis of the events (Webster & Mertova, 2007) helped me develop the meanings of the actions and reflections. For that, I subscribed to the different paradigmatic positions that allowed me to make sense of various actions conducted collaboratively in the field. I attempted to use a multimethod restoring framework for narrative analysis, where co-creating stories and making co-creation are essential for the progression of stories (Nasheeda et al., 2019). While analyzing the narratives, I critically discussed the events by illuminating the values, assumptions, and deep-seated beliefs and practices of the co-researchers and other stakeholders. For this, I subscribed to the ideas of critical reflection (Mezirow, 1991) and ideology critique (Geuss, 1981), which helped me develop a critical awareness of how ideologies serve interests by analyzing their historical roots and assumptions.

Save the Species: I Keep Water Plates on the Roof for the Birds

Out of several collaborative activities, the "Save the Species: I Keep Water Plates on the Roof for the Birds" project was developed and implemented as a part of the transformative STEAM project. During this project, we, as co-researchers, worked in teams and used our skills as communicators, researchers, collaborators, and creative problem-solvers by developing a prototype that protects species (birds in this case) in the designated areas.

The lesson had three objectives. We initially focused on developing solutions tailored to the requirements of a designated conservation area through a design challenge activity. Secondly, our goal was to enhance ideas by incorporating feedback from another team, and thirdly, to articulate how the solution tackles the problem and conveys an impact narrative. The project was implemented in the action school. A group of students from grades 7 and 8 was selected after discussing with them. They were excited to participate in this activity, as they said that they love species and are motivated to save them. The students realized several birds and other species were nearby the school when they were children. Gradually, the trees were cut down, and the houses were built. As a result, the birds started to disappear. When we asked them whether they were interested in developing some habitats that support birds, they were very motivated.

First, they were asked to create a model of birds' inhabitants using paper and other local resources. While doing this, each group provided feedback to the other group. They developed the updated one by addressing the feedback received from teachers and other students. Finally, they collaborated with carpenters to develop nests of birds and kept them in the school's garden. They were also asked to explore different ideas associated with the nest of birds from the perspectives of STEAM Education. Students shared the entire process of developing the bird's nest and the product.

At first, we conducted a brainstorming activity. Initially, a discussion question was presented for silent brainstorming. The inquiry was related to the functions of species in human existence and the necessity for conservation. Students presented their anecdotes, preferences, and dislikes. It created a comprehensive context for the lesson plan. Each group explored environmental conservation and sustainability challenges while actively engaging in brainstorming exercises. Participants were allotted 10-15 minutes to go around the room and write or draw their thoughts on a piece of paper based on a given word, like conservation or sustainability. Students were instructed to utilize sticky notes to write on and attach to the paper. The entire group reflected and generated multiple ideas regarding appropriateness and preservation. For example, one group shared that the birds are needed to maintain the ecosystem.

The second activity involved watching a video. The video was shared with the students in the computer lab. The purpose of showing videos was to connect their preliminary ideas with the others' ideas while conserving birds and other species. Watching the video helped raise awareness about the importance of conserving birds and other species, as it presented numerous data and evidence that demonstrated the impact of species loss on human life. The third activity was the "Design Challenge". One of the major purposes of this activity was to provide opportunities to engage in design challenge activities. In this stage, students were asked to share different ideas for conserving birds and other species. They were asked to think from the perspective of a sustainable environment. One reference material also allowed them to read and explore similar activities that can be performed in their context. The introduction to design challenges was made with several real-world examples. Finally, they were asked to explore the issues (how to save the species). They were also asked to connect with the reading resources and videos shared before.

The next day, revisions were made to their preliminary design of the bird habitat. Some students produced different ideas, such as we can perhaps work on legal provisions for plantations around our house. We asked them to develop a solution with the available materials in the room, and we provided a few materials, such as paper, glue, and scissors. The students were divided into four groups, and all groups started to work on making a nest for the birds. They presented models of different nests for low-flying birds. Once they had prepared different models of nests, they were ready to collaborate with carpenters to prepare nests of wood. Some said that we do not need support from the carpenter. Some said that we need some support to cut and make a good shape for the birds. Finally, each group developed a small nest. The students shared that the birds will stay if we prepare nests and provide food and water for them. The birds will reproduce more birds, and the entire environment will be sustainable.

Each group kept the nests in the school garden. They also discussed different concepts of mathematics (area, perimeter, volume) and social studies (such as preserving nature, and making the world a home for all creatures) used while preparing the nests and the entire project. One of the students shared that we should also make such nests in our houses. Several challenges appeared at the beginning. When we asked schoolteachers at first regarding implementing such an innovative project, several teachers responded that these activities were not necessary for students. It is time-consuming, and we cannot cover the courses if we allow students to participate in such activities. Gradually, when teachers observed all the activities

conducted by their students and their motivations and creativity, they realized that this was a good approach for experiencing real-world tasks. Another challenge is to fight against the culture of expecting tips, tricks, and techniques from teachers and students.

A male teacher who was working as a focal person in this project shared.

> In the beginning, when a researcher from the University shared about this project, I thought this was not needed. This was like an additional burden as we had a lot of content in our textbooks. But, later, when I became a part of the project "Save the Species", I was amazed by the interaction of students and their creative and critical understandings of the subject matter. I never thought that my students could engage in such a level of confidence. Thanks to the entire research team.

Similarly, a female teacher who was involved in this journey said.

> When I learned about this project, Save the Species, I went through them. I found the implementation ideas to be rich and useful for children. The details of the activities with a list of materials helped me a lot in implementing them. I listened to STEAM-based projects several times on different platforms, but have not received such a rich platform.

Other teachers who have closely observed the entire process of making bird habitats seemed very motivated. The students involved in this process shared several encouraging remarks during the project implementation. In this regard, one student from seventh grade shared.

> It was a great learning experience to participate in the lesson "Save the species." I developed a model of birds' nests at school and later refined it at home. I have also planned to do the same for my home. I wish our regular teachers' similar activities, too.

Another student from eighth grade shared.

> The product we developed (birds' nests) was not so new for me. However, the group work and sharing provided me with rich opportunities to increase my confidence. I liked the ideas of design thinking. It became beneficial for me to think outside the box.

Similarly, another student shared that this project touched my heart. I gradually started to care for the birds. I discussed it with my parents and kept a plate with water on the roof. I have seen a few birds come to drink water in winter. I think it's our responsibility to save animals and birds, too.

From the above actions and reflections of students and teachers who participated in the entire project implementation, I realized that the implementation of the STEAM project is challenging but useful. The entire activity was highly participatory, where we shared our ideas, had debates, reached a consensus, and moved ahead with the implementation, followed by reflective sessions. Utami et al. (2024) conducted research and concluded that by incorporating themes such as environmental sustainability, social justice, and economic development into the curriculum, teachers can promote a more holistic approach to education and empower students to become active global citizens. The integration of STEAM-based projects and SDGs has broad implications for the future. For conducting such activities, teachers should be aware of the deeply rooted notion of disciplinary egocentrism, which most teachers normally do not

acknowledge, and that they do not acknowledge the presence and contributions of other subject matters in project-based learning. According to Connor et al. (2015) disciplinary egocentrism develops in educators who focus solely on the content of their disciplines without understanding the relationship between their subject matter and that of other disciplines. Pant et al. (2023a) state that disciplinary egocentrism prevents students and teachers from thinking beyond their disciplines. It may deter instructors and students from embracing alternative modes of knowledge. In the context of STEAM project implementation, school pupils develop rich learning experiences. In the case of routine-based tasks, students memorize pre-established ideas and exhibit a lack of creativity, resulting in a procedural understanding of the topic (Baker et al., 2004). Rittle-Johnson et al. (2015) found that only concentrating on procedural understanding, which involves the ability to execute action sequences (i.e., previously learned step-by-step solution method) to solve routine problems, does not support the development of students' relational and conceptual knowledge. Several studies (e.g., Shrestha, 2018; Manandhar, 2018) have also demonstrated that the Nepali school education system lacks relational knowledge because it emphasizes a fragmented approach to learning.

The current debate on curriculum integration (and thus in the pedagogical arena) has provided researchers and educators with food for thought regarding accepting alternative methods of knowing. According to Slattery (2012), academic disciplines are heavily influenced by positivistic (i.e., scientific) tendencies toward fixed categorization that lack the potential for multiple interpretive possibilities and assist students in viewing the world through novel and diverse lenses. In the same vein, Beane (1997) has argued for curriculum integration, in which significant problems and issues must be incorporated into the curriculum design without much regard for the subject boundaries identified by educators. Beane's ideas are primarily persuasive for two reasons: the first is his argument for the need to cross the boundaries of disciplinary segregation of knowledge, and the second is that young people (especially students) should be involved in the curriculum's development process. Similarly, Barsky (2019) argues that an integrated curriculum should incorporate ethics and values. The concepts of ethics and values are highly congruent with an arts-integrated approach to education. In this initiative, students learned that our responsibilities to conserve species are related to traditional school subjects (mathematics, science) and ethics.

There are three distinct cultural ways of understanding nature, as argued by Aikenhead and Ogawa (2007). One approach is indigenous, which could utilize the artistic way of knowing as it is based on myths, spirits, and ancestors. Another approach is the neo-indigenous way in which a concept is proposed to recognize the unique ways in which many Asian nations use this way of knowing nature. Next, the Euro-American scientific approach considers science as a rational, empirically based way to explain and describe nature, partly based on descriptions and explanations. Nepal indeed has several indigenous practices, and indigenous ways of knowing should be placed at the center, but in the name of scientific knowledge, the Euro-American scientific ways of knowing have become dominant (Lamichhane & Luitel, 2022). Regarding the teaching and learning activities, the collaborative approach, as per the ideas of social constructivism (Vygotsky, 1962), became useful while making bird’s nests and keeping them in the garden. I, along with schoolteachers, supported students, keeping the idea of scaffolding (Vygotsky, 1962) at the center by providing individual support as per their needs.

Critical Moral Pedagogy has been considered an educational approach that integrates the principles of critical pedagogy (McLaren, 2023) and moral education (Berkowitz, & Oser, 2013). The notion of critical moral pedagogy directs the development of ethical responsibility and a commitment to change society by maintaining social justice among learners (Darder et al., 2023). It emphasizes moral agency and empathy by addressing systemic injustices and global challenges (Auh & Kim, 2024). It encourages learners to critically examine their deeply rooted values and assumptions while understanding ethical issues from diverse perspectives.

In the project, "Save the Species: I Keep Water Plates on the Roof for the Birds," we, as co-researchers, observed that students' responses towards the preservation of birds in their community indicate the beginning of the examination of their assumptions about birds and other species.

While developing and implementing the above project, we created several dimensions of transformative STEAM projects. As coresearchers, we discussed that the construct "transformation" has been used and misused in several places. The arguments for the transformative in school education are multifaceted and multilayered; they are connected and interrelated. I try to unpack those ideas based on my experiences working in the field and interacting with several pieces of literature.

Transformation is Thinking

The transformation process, especially when considering personal and societal change, originates inside the domain of the mind. It is a cognitive process that entails restructuring our cognitive schemas, convictions, and viewpoints. From this lens, transformation is also a mental process. It involves questioning established beliefs, assumptions, and values and substituting them with novel and more advanced ones. This process is essential for human development, acquiring knowledge, and adjusting to new contexts or circumstances.

Innovation serves as the driving force behind change. They encourage us to challenge our existing comprehension and expose us to alternative viewpoints. It is not solely about gaining new knowledge but rather about welcoming and acknowledging new perspectives to incorporate and merge this new knowledge in a noteworthy manner. Another critical concept is cognitive dissonance and its role in transformation. Cognitive dissonance is a crucial factor in the process of transformation, and the transformation approach involves inducing cognitive dissonance to prompt individuals to rationalize and accept change (Çalışkan & Gökalp, 2020). Cognitive dissonance is a psychological condition that makes people feel uncomfortable and confused, which makes them rethink what they believe or how they see things. We feel uneasy when we come across thoughts that contradict our current views. The experience of discomfort can serve as a potential catalyst for change. It compels us to resolve the contradictions between our current beliefs and attitudes by modifying them. In the same direction, Jack Mezirow's (1991) conceptualization of a disorienting dilemma is a crucial element in the transformative learning theory. The concept of a disorienting dilemma is the initial stage or aspect of transformative learning, in which humans modify and reinterpret their overall perspective on the world once they encounter a disorienting dilemma with the existing conditions and situation. An inexplicable dilemma refers to an encounter that cannot be comprehended or addressed within one's existing understanding or worldview. A transformative experience is usually an extremely difficult, significant incident or circumstance, leading the person to challenge their deep-rooted assumptions and beliefs carefully. This also demonstrates that transformation is thinking, and transformations begin with thinking.

Hoggan (2023) critiques Transformative Learning (TL) scholarship in the editorial "The 7 Cardinal Sins of Transformative Learning Scholarship". Transformative learning is commonly linked to Mezirow's theory of perspective transformation, although contemporary critiques rarely address TL's broader breadth. Failure to identify change, excessively employing Mezirow, and ignoring contemporary scholarship are major mistakes. Other concerns include not critically engaging with theories, claiming that all learning is transformational, claiming that educators can transform others, and assuming that the primary objective of education is transformation. Hoggan encourages researchers to deepen the TL dialogue and interact with novel thoughts to ensure the discipline grows more productively.

The paper emphasizes clarity, theoretical engagement, and critical thinking as crucial for transformative learning theory and practice.

So, it is essential to exercise critical thinking during the transformation process. The notion of critical thinking begins with a mental process. It entails more than simply accepting new ideas without question, but actively examining and questioning the existing actions and systems. Such mental activities contribute to developing a more refined understanding of events and society. There are social aspects of transformation as well. Stetsenko (2017) places significant emphasis on the social dimension of transformation by participating in social activities to co-create knowledge. Our cognitive processes are not formed independently but are profoundly shaped by our interpersonal exchanges and cultural atmosphere. Therefore, it is important to be involved with many different points of view if we want to understand things better and encourage revolutionary thinking. Education is a key part of making change possible. The goal is not just to impart knowledge; it's also to develop the skills and attitudes needed for critical thinking and being open to new ideas. Schools need to encourage students to question, discuss, and look into different points of view. For this, thinking towards the betterment of society is the point of departure for the transformation. The project developed by co-researchers and implemented in the school provided several opportunities for students to develop critical thinking.

Such opportunities are also known as authentic contexts for critical thinking. Solving challenges and problems that are unclear, complicated, and closely reflect real-world problems is highly valued in authentic learning (Herrington & Kervin, 2007). A study by Dolapcioglu and Doğanay (2022) presented several viewpoints on mathematics education by emphasizing the development of critical thinking abilities required to comprehend mathematics. Six cycles of the study were conducted using an action research method. The information was gathered from students' written papers and journals, their CTR (Critical Thinking Rubric) ratings, and unstructured observations. The study's findings demonstrated how activities grounded in real-world learning standards enhanced students' critical thinking abilities in understanding, comparing, verifying, coming up with original ideas, and considering how they solved problems. It also demonstrated that rich activities lead to critical thinking. People tend to be resistant to change by nature. To get around this, it takes a conscious effort to remain open to new ideas and to be ready to examine and adjust our beliefs as they stand. It is a continuous process of self-reflection and development.

In summary, transformation mostly focuses on how our cognitive processes evolve and progress. This process involves embracing new ideas, challenging deeply rooted beliefs, and continuously working to increase our understanding of the cosmos. This process is not just a personal enterprise but a socially integrated one, needing involvement with a wide range of ideas and notions.

Transformation is a Conscious Attempt

While working with co-researchers for several months in the initiation stage of the fieldwork, I, as a lead researcher, sometimes realized that the time and effort we gave to the research field had not produced any remarkable changes. There were several such moments I went through where I had a fear of whether my/our attempts would be meaningful. I was expecting the visible changes in a short period of time during the initial stage. My limited understanding of PAR initially forced me to conduct activities that make a loud noise in the community and might get media coverage.

But, lately, I realized that PAR is not a quick-fix approach (Pant et al., 2023b). Naturally, it takes considerable time to show the visible changes in the community. From this perspective, I sensed that transformation is a conscious attempt. An attempt was made to make

changes in the direction of transformation. In action research and PAR, we do not claim any ideas as knowledge until they are implemented and reflected. Knowledge is claimed once it is demonstrated with actions and reflection (Chiu, 2006; Chevalier & Buckles, 2019). As a PAR researcher, I am aware of the ongoing nature of actions and their influences or impacts on the field. But, at a certain point in time, towards the middle of the second cycle, I developed a view that the actions are being implemented with a purpose, and all efforts are conscious attempts. Such conscious attempts (whether they positively impact the research site or not) always give lessons for co-researchers and the communities closely observing the actions. If the actions bring positive impacts (such as improving students' performances, enhancing teachers' capabilities in making and implementing pedagogical plans and connecting community practices into the school system), we might use similar approaches in the other institutions (such as reference schools in the case of this study). If the expected outcomes are not reached from our actions, we will learn many things that ultimately lead us toward the path of transformation. First, it provides us with evidence of the failure to succeed. This is also knowledge we require from all attempts. Second, it helps us to develop another set of actions for further implementation. Third, as researchers, we receive knowledge and realizations that develop our professionalism. In this research study, we, as co-researchers, developed several skills and knowledge throughout the entire journey. There were several attempts that did not happen as planned, such as the development of local curriculum and maker spaces with indigenous equipment and practices. However, I sensed that it was a conscious attempt for transformation. One of the dimensions of transformation is to have a conscious attempt. As Tripp (2005) argued, the term action research is often loosely applied to any attempt to improve or investigate the practice. The conscious attempt also relates to consistency in actions, in which we do not always expect changes overnight. However, we, as humans, make persistent efforts for the betterment of societies.

Transformation is a Process

It was a day in June 2023. I was sharing our collaborative actions on the research site during one of the national webinars. I received a question in the chat:

> You shared several things that confused me. Will you please share the exact output or impact in bullets?

It was a public forum. I shared a few specific outcomes that were achieved through our actions. But this made me thoughtful about myself. Why do people expect to listen only to the product or output? In an educational setting, what is the importance of input and process? Can the product (i.e., achievements) be independent of input and process? As per my understanding, the process means the entire journey (path), an important aspect of PAR, and the most important aspect of the transformation. Grounded on the ideas of continuous engagement for transformation and multiple ways of knowing, Taylor and Taylor (2022) argued that:

> Transformative learning involves students developing a range of *transdisciplinary capabilities* in conjunction with STEM-related disciplinary knowledge, skills, and values. Transdisciplinary capabilities expand students' ways of knowing about and valuing their inner worlds, especially how their valued belief systems frame or limit their understanding of the outer world and their participatory relationship with it. (p 11).

For this, we should engage students in the process of learning. Sometimes, engaging in the process cannot be well documented by grades and results. However, the skills and knowledge learned from the entire process might help students develop critical sensibilities about societal issues. The integrated nature of the projects we implemented was a great learning experience for students, teachers, and community members. In the project, Save the Species, students engage in the process of developing birds' habitat through the design-thinking process. This helped students uncover deeply rooted beliefs about species preservation in the community. This might or might not be able to support the grades in the subjects (mostly valued in the conventional education system). However, such opportunities to gain insight into the investigation process will certainly help students develop a critical understanding of societal issues.

Transformation is a Product

The idea of transformation is multifaceted, as I shared in the previous section. One of the dimensions is several achievements (normally considered products) during the journey. These can be viewed as products in the continuum of the transformation. Those products are not ultimate; rather, these are the basics for another achievement. This is one of several milestones in the journey of transformation.

As a product, transformation is seen in the tangible outcomes gained through the collaborative actions taken in schools. One of the products we experienced was the improvement made to instructional methods. The change in instructional methods is one of the most obvious outcomes of the transition that has taken place. Teachers began implementing inquiry-based, project-based, and STEAM pedagogy to transition from conventional lecture-based approaches to more interactive and investigative exercises. This transition is not solely a process but also a visible outcome reflected in the quality of classroom interactions, lesson plans, and the pedagogical approach.

The next product is students' performances. Performance is more than learning outcomes defined in the curriculum. The impact of the transformative STEAM project on student learning is another important result of change. Using integrated teaching approaches frequently results in enhanced critical thinking, problem-solving abilities, and a more profound comprehension of the ideas being discussed. The narratives presented in the above sections of the same chapter demonstrated that students started to think from the perspective of social justice and their responsibility to make their families and communities a just society. This is what Freire (1970) mentioned: education aims to help students develop a critical awareness of the subject matter and connect with the ongoing practices of societal activities. Assessing students, having them work on projects, and observing how well they can apply what they have learned in real-world situations are all ways to measure the products. One of the most obvious outcomes of the transformation is the improvement in the level of engagement and learning among students.

One of the transformation results is the creation of learning resources that combine approaches such as inquiry-based learning, project-based learning, and transformative STEAM education. When students and teachers engaged in developing birds' habitat, few teachers and students reached the level of autonomous participation, as Pant et al. (2023b) mentioned. Autonomous participation is the highest level of participation where co-researchers themselves take the initiative to improve their actions. This includes the development of new curricula, course materials, and other resources that align with these methodologies. The curricular materials are tangible products that show the transformation in educational techniques that have taken place.

Next, the transformation happened in the nature of teachers' professional development activities. The conventional methods of teacher training (i.e., sessions delivered by experts) have been challenged since the beginning of the projects. The co-researchers who were a part of the entire initiative have started a culture of sharing ideas and contributing to the sharing and reflection sessions. When I joined the team, I also followed the same principles. The expectation of receiving readymade techniques by university researchers has already been minimized. In this context, I sensed that schoolteachers were on a journey of transformation in their professional development. The development and implementation of transformative STEAM projects and participation as co-researchers in the PAR journey were instances that contributed to the ongoing professional development of teachers. The evidence can be noticed in the confidence level of teachers while sharing their ideas, pedagogical expertise, and the ability to share/influence other teachers for their professional development. These were the concrete products of their involvement in the transformation process.

In a larger sense, transformation can result in institutional change within educational systems or institutions. This change can be a consequence of the transformation. Croeser et al. (2024) offered insights into how funding agencies and project teams can design demonstration projects to improve the chances of replication better and thereby progress towards transformative change by using action research. In this research journey, I collaborated with the entire research team to lead schools in the journey of transformation, together with the professional development of co-researchers, including myself. The changes in educational institutions can be seen in the modification of educational policies, the reorganization of educational programs, or the implementation of new teaching standards that are supportive of engaged learning approaches, which were discussed in the narratives of this chapter. These kinds of institutional shifts are important goods that are the result of the transformation process. I, as a lead researcher, have initiated, guided, and witnessed this journey of transformation of the school and teachers.

Next, the change could influence people outside of school and in the community. This includes making links with local groups, getting people in the community involved in school projects, and helping people in the community understand education better overall. Change has led to several important results, and one of them is that towns and schools are now better able to work together. Eccles and Roeser (2015) examined the consequences of educational institutions as essential environments for the progress of society, with an emphasis on their influence on diverse facets of the lives of children and adolescents, encompassing not only educational achievement but also the formation of morals and character. The authors acknowledge the complexity of these influences and the necessity for comprehensive approaches to study them by drawing on interdisciplinary perspectives. In this regard, I have experienced that the transformative STEAM projects conducted in the school system provided a ripple effect on the community level in terms of farming and other entrepreneurship activities.

Transformation is a Basis for Sustainability

One frequently raised question in the entire research journey, including the conference presentations, was how to ensure the ongoing actions are sustained after the research work. In fact, this was one of my questions until the middle of my field engagement. As we progressed, the collaborative actions and the discourses we created in the schools and community developed confidence in sustainability. One of the major evidence for the sustainability of the actions was the teachers' demonstration of self-initiative in activities, which signifies a sense of ownership and empowerment concerning the educational process. This is of the utmost importance for sustainability, as it transforms the initiative's motivation from external to internal (Taylor & Taylor, 2022). Furthermore, during the process, we, as co-researchers,

realized that teachers are more inclined to innovate, adapt, and maintain activities that hold significance within their context when they experience a sense of empowerment.

Another important aspect of sustainability is due to community engagement and support for continuing the school's initiatives. The parents and community members observed the pedagogical innovations of project-based learning, and teachers' involvement in making project, Save the Species. A robust community engagement is indicated by the active participation of the local community and the support that is received. This is a fundamental element of transformative actions, in which local support for the activities guarantees that they remain grounded in the requirements and values of the community, thereby increasing the probability of their sustained relevance and continuity.

During the fieldwork, teachers from the action schools received several opportunities to share their practices with the teachers at other schools in the programs organized by the local government. It also signified that teachers' efforts and achievements were recognized at the government level. Such an environment motivates teachers to continue their practices so that their actions will get attention and be valued in the future. Such actions contributed to a more sustainable and transformative educational environment by disseminating the principles of empowerment and community engagement, thereby potentially generating a more extensive influence. Wamsler (2020) discussed the issue of how sustainability doesn't pay enough attention to the inner aspects and skills necessary for good sustainability learning and decision-making. It gives an in-depth look at a unique class called "Sustainability and Inner Transformation," which shows a strong connection between changing oneself on the inside and being environmentally friendly in school. The results show that focusing on inner aspects can help people think more critically and make better decisions when it comes to sustainability. The paper sets an innovative example for other universities and training institutions, giving them ideas and lessons for making sustainability education more comprehensive and effective.

Concluding Remarks

Participatory action research to execute the STEAM project in Nepali schools has shown that transformation is a complex interaction of thinking, conscious efforts, and process. The collaborative actions led to the conclusion that the transformation begins with thinking, according to the study. STEAM programs challenged the "grammar of schooling" of topic segregation and rote learning. It was confusing for students and teachers: How can math, physics, social studies, and art solve a problem? Designing a bird's nest that is mathematically accurate, scientifically sound, socially meaningful, and artistically creative? These inquiries caused cognitive dissonance, forcing teachers and students to break discipline norms. Transformation as thinking involves actively questioning old ideas, disturbing strongly held beliefs, and opening up to diverse views. The idea that transformation involves intentional effort is crucial. The co-researchers and lead researcher cycled between activity and reflection, experiencing skepticism and concerns.

The journey is fundamental in the third dimension, transformation as process. Modern education emphasizes outputs, measurable results, and standardized success indicators. The lived experiences of this research show that process - dialogue, scaffolding, co-creation, and reflection - is just as important. The project produced a dialogical environment where teachers and students imagined new pedagogical possibilities. Because it prioritized participation, cooperation, and relational knowing over set objectives. The entire process was revolutionary.

This research also helps in curriculum integration debates. PAR showed that education may integrate scientific, mathematical, artistic, cultural, and ethical knowledge without silos by embracing STEAM. The "Save the Species" project showed how sustainability education can involve students in authentic, intellectually, emotionally, and ethically engaging tasks. The

STEAM project allowed instructors to rethink their roles. The reflections illuminated students' creativity, critical thinking, and collaboration. The initiatives helped students develop confidence, empathy, and problem-solving skills that extend beyond subjects and prepare them for ethical and responsible citizenship. Resistance to disciplinary egocentrism is also stressed in the study. A subject-centric approach limits overall learning. The research also emphasizes that structural barriers such as curricular rigidity, exam demands, and deep-rooted teaching habits present considerable problems. Thus, transformation is a cultural transition that requires ongoing work and institutional commitment, not a set of tools. Finally, transformation is multifaceted. Thus, educators should go beyond simple change concepts. Thinking, purposeful efforts, and continual processes create transformation. It requires humility, persistence, and critical thinking.

Data Availability Statement

The raw data supporting the conclusions of this article will be made available by the author, without undue reservation.

Ethics Statement

The study involving humans were approved by the Research Committee at Kathamndu University School of Education, Lalitpur, Nepal. The study was conducted in accordance with the local legislation and institutional requirements.

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Conflict of Interest

There is no conflict of interest reported by the author in the article.

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