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The Nature of Steam Education Curriculum in Nepal

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The long tradition of the conventional nature of education characterized by a behavioristic model of educational practices in Nepal and beyond appeared as unhelpful and disempowering enterprises. Such a model of education survived under the compartmentalized nature of curriculum where pupils did not find the connection of one discipline/subject to others as well as the connection of curriculum materials to the real lifeworld. More so, the existing discipline-based education focused on rote memorization of the facts and information without focusing on 21st-century skills. In such a context, there was a visible change in education from Kathmandu University to start a popular program – STEAM Education. With the increasing awareness of people in the program, schools are now implementing STEAM as a pedagogical approach. Similarly, there is a good initiative from the government of Nepal to implement an integrated curriculum from 1 to 3. In such a context, there should be an authentic model of a curriculum which serves the principles of STEAM education. This paper was extracted from the first author's MPhil dissertation. Employing argumentation as a method of inquiry, this paper explores the various curriculum dimensions of STEAM education in the context of Nepal. The data came from the experiences of the author's experiences as a STEAM advocate, a teacher educator, and a STEAM-based program developer. The findings of this paper can be significant for everyone who is seeking change through STEAM education.

Keywords: *STEAM Education, STEAM curriculum, Holistic Education*

THE DISCIPLINARY BOUNDARIES IN EDUCATION

The nature of curriculum as a subject matter to be taught and curriculum as discrete tasks and concepts have become the dominant factors for the reproduction of knowledge. These curriculum images as discussed by Schubert (1986) are the foundations for the existing context of education which promotes the memorization of facts and information, value of collection of algorithms and rules, decontextualized contents and concepts, and eventually the compartmentalization of disciplines and subjects (Pant et al., 2020; Manandhar, 2021). In such a situation, content knowledge is provided as information by assuming students grab it having a complete mastery on it and by ignoring the essential life skills. The focus of discrete tasks and concepts to prepare a student as an expert in a particular field has become a taken-for-granted assumption. As a result, there appear to be boundaries among the subjects as if they were developed in the different planets. The pedagogical practices drawn from such images of curriculum prioritize the technical and sometimes practical human interest, thereby ignoring students' inherent capabilities, diversities, and skills for solving the complex real-world problems.

In the disciplinary boundaries, disciplines are taken to be separate and distinct from one another. For example, mathematics and science are different, and there needs to be different and separate abilities to deal with the concepts in these subjects. Consequently, teaching and learning practices follow the compartmentalized nature of education with a separate teacher, separate routine, separate table of contents, separate pedagogy, separate assessment practices wherein a particular student or teacher is not able to link academic contents to other disciplines; moreover, s/he does not find the application of disciplines/subjects in day-to-day life. If we talk about the existing and conventional model of education, subjects are divided separately, curricula are developed for separate subjects, teacher preparation programs are designed based on the

disciplines/subjects, and execution of knowledge delivery runs for separate subjects. This might be one of the reasons for having a poor performance of the school students in higher cognitive abilities such as applying, analyzing, evaluating, and creating (Education Review Office [ERO], 2020). ERO also claims that students are weak in conceptual understanding, critical thinking, creativity, etc. Moreover, this could be the reason behind having unsatisfactory achievements of the students at all levels (Poudel, 2017) and educational experiences being largely negative (Pant et al., 2020).

STEAM EDUCATION IN NEPAL

The situation of fragmenting subjects and disciplines needs a complete reform in education to break the boundaries of subjects/disciplines in the contexts of Nepal. Nepali educators (e.g., Pant et al., 2020; Shrestha, 2018, Pant, 2015) have emphasized on integrated nature of curriculum, innovative and progressive pedagogical practices, authentic and performance-based assessment strategies in education to make holistic education work. The initiation of STEAM Education program at Kathmandu University is one of the changes we can consider. This educational model is emerging and gaining popularity all around the world. Here, STEAM is an acronym for five interconnected subjects: science, technology, engineering, arts, and mathematics. These most common and essential four subjects are inextricably connected, and the STEAM approach is supposed to present contents through the usage of arts, and this seeks an integrative nature of the curriculum. National Curriculum Framework for School Education (NCF) (2019) of Nepal developed a policy for developing an integrated curriculum, and it has been implemented from 2020 throughout the nation. The major emphasis of this curriculum is to use the thematic method of teaching and learning with the help of multidisciplinary and interdisciplinary curriculum integration, which allows holistic learning to solve real-world problems (NCF, 2020). In this, the curriculum organizes interrelated disciplines and learning contents to promote integrated learning experiences and develop interdisciplinary skills focusing on transversal skills (UNESCO, 2015). So, this is one of the initiations by the government towards STEAM and integrated learning.

The central principle of STEAM education is to emphasize integrated learning which helps students to connect academic subjects/disciplines with their real-world and do continuous innovation in various areas. It includes the innovative pedagogies such as inquiry-based, project-based, technology-enhanced, arts-based (storytelling, dancing, sculpturing, etc.) pedagogies that help students develop their communication, collaboration, creativity, critical thinking, curiosity, etc. In the importance of arts, Eisner (2002) emphasizes the role of arts by saying, 'education, in turn, is the process of learning to create ourselves, and it is what the arts, both as a process and as the fruits of that process, promote' (p. 3). To transform the human consciousness, arts could play a crucial role which is not only the way of creating performances and products; it is the way of creating our lives by expanding our consciousness, shaping our dispositions, satisfying our quest for meaning, establishing contact with others, and sharing a culture (Eisner, 2002). In the same line, Sousa and Pilecki (2018) illustrate the benefits of arts integration in learning, such as arts engage the young brain, develop cognitive growth, advance social growth, introduce novelty, improve long-term memory, reduce stress, and make teaching more interesting. Moreover, arts help to develop empathy can be a powerful tool for releasing the imagination for possible social transformation and actions (Greene, 1995) wherein 'aesthetic experience as a means might awaken students' consciousness for advancing democratic values with multiple perspectives, freedom, and responsibility' (Moon et al., 2013, p. 223). Thus, STEAM education is powerful through integration of arts.

RESEARCH PURPOSE

The purpose of this argumentative paper is to explore curriculum dimensions of STEAM education for the effective implementation of STEAM education in the context of Nepal and beyond.

THEORETICAL PERSPECTIVE

We used constructivism learning theory in this paper. Constructivism believes that the knowledge construction process is active learning where learners are at the center of learning activities, and they engage actively to construct knowledge (Major & Mangope, 2012). In this, knowledge is made or constructed by learners, but it is not given. In the process of learning, via the constructivist eye, a continuous adaptation (von Glasersfeld, 1995); active interaction among peers, people, and materials are essential to collaboratively create knowledge, etc. For STEAM education, the pedagogical and assessment practices are more innovative and progressive which are the product of constructivism learning theories.

Moreover, we also used the holistic education concept as a referent in this research. The primary emphasis of holistic education is on the overall development (i.e., physical, emotional, intellectual, social, aesthetic, and spiritual development) of the individual (Mahmoudi et al., 2012; Rudge, 2010). Amid the major concerns of the present model of education in the development of basic knowledge and skills, holistic education advocates for nourishing the inherent possibilities of human development, thereby connecting an individual to life, society, the worlds, and the entire cosmos. By supporting this, one of the holistic educators Ron Miller (2006) admits, "Holistic education aims to reconnect each person to the contexts within which meaning arises: the physical world, the biosphere, the local community, the culture with its many layers of meaning, and the cosmos itself" (p. 29). Here, we advocated for arts-integrated, technology-integrated, and transformative methodologies of teaching (learning by doing and reflecting). Similarly, the major emphasis of the integrated nature of curriculum seeks a balance between mind and body, linear thinking and intuition, self and community, and various domains of knowledge striving for developing a conscious awareness of the relationship between the earth and the soul (Miller, 2000, 2007).

RESEARCH METHODOLOGY

The paper was extracted from the first author's MPhil dissertation in STEAM education. The second author was the supervisor of the research and remaining authors were the critical friends who provided feedback throughout the research process. The dissertation was done by using the evocative autoethnography Method. This paper was developed through argumentations as a method of inquiry where we tried to justify and validate the ideas through a rigorous review of recent literature. Similarly, the theories were used as referents for making the discussion more evident and authentic. The data were collected from the experiences of the authors, reflections from the schools and teachers who use STEAM education as a curriculum and instruction practice, and available recent literature in STEAM education.

FINDINGS AND DISCUSSIONS

The Nature of STEAM Curriculum

Formal education was seen to be separated from the lifeworlds of people as if academic subjects

might come from segregated planets. Students used to study eight or more subjects with separate teachers in the archaic model of education and curriculum that might be unsuccessful in many ways which emphasized on compartmentalization of subjects, thereby forcing students to learn in a narrowly conceived and bounded criterion or objectives of the separate subjects. Moreover, you might have also experienced those students are not likely to be capable of real-world application of those ideas and skills learned in the formal academic setting. For instance, a student's family has a vegetable garden, and his/her parents in the business of selling those vegetables in the local market. However, s/he might not have the ability to help parents in their household chores and business with those formal academic experiences. The situation might present the context of how formal education and lifeworlds of students are separated. So, the context is apparent for a big failure of education as there are issues such as disengagement, disinterest, negative attitudes, raising dropout rates, unemployment, among other critical issues. As a result, that seems to be a factor to negatively affect the progress of individual as a person, society, and the world. However, the STEAM curriculum can be useful for solving these issues.

The contemporary integrated curriculum of Nepal has been governed by the notion of interconnectedness: a holistic educational principle that every element in this world is interdependent – one can exist depending upon the other (Nakagawa, 2000; Rudge, 2008). There are three forms of curriculum integration: multi-, inter-, and trans-disciplinary. If we put these in a continuum of curriculum integration, multidisciplinary nature lies within the least integrative form of integration which involves the knowledge, processes, and skills more than one discipline through theme-based teaching. In this regard, the present integrated curriculum of Nepal seems to be heavily guided by the notion of multidisciplinary integration. To understand this, let us take an example, 'kitchen garden' could be a theme. Now, the concepts and skills of several disciplines or subjects can be developed, centralizing this theme. Teacher can teach several concepts of science (soil, plant, environment, etc.), mathematics (area, height, patterns, numbers, basic operations, etc.), engineering and technology (designing the plot, researching through internet), and arts (making garden appealing to other or could write poems/songs or make a painting of beautiful kitchen garden, the humanity of being together, etc.). The subjects or disciplines are organized in a theme rather than an orientation towards an authentic problem (Wickson et al., 2006). So, this approach of curriculum integration might not be helpful because there is still a space for separate disciplines to be predominant or we can still separate the disciplines. *How can teachers integrate real-world problems faced by students and a larger community of people?*

Interdisciplinary and transdisciplinary natures must be the features of STEAM curriculum. Interdisciplinary approach perhaps emphasizes on common interdisciplinary skills and concepts embedded in disciplines wherein knowledge is socially constructed, having many right answers (Drake & Burns, 2004). In this approach, students and teachers involve in collaborative projects to address specific 'real-world' problems and, as a result, encourage students to create new knowledge across the disciplines (Stock & Burton, 2011). For instance, the above example (Kitchen Garden) can be applied in interdisciplinary teaching and learning if we allow students to ask questions across several disciplines with the motto of cultivating interdisciplinary skills and we put some real-world issues like how you would save your kitchen garden from predators. What happens to vegetables when suddenly the weather changes? This might enrich students' 'thinking out of the box' skills with real-world application of knowledge. In doing so, they can develop a kitchen garden through painting, or they can develop a song related to the same to make learn fun and effective. The transdisciplinary nature of STEAM curriculum is a paradigm shift in curriculum integration that might fundamentally focus on a real-world problem-solving

approach (e.g., through project-based learning) wherein students are encouraged to develop life-affirming skills as they apply interdisciplinary concepts and skills in a real-life context (Drake & Burns, 2004). This might often go beyond the disciplines while producing a new perspective (Gibbs, 2015). Students, whilst solving authentic problems, could develop creativity, ingenuity, curiosity, imagination, critical thinking, productivity, and accountability. Let's understand this through an example. We are taking one of the major earthquakes of around 7.5 rector scale that happened in 2015. The project can be following:

You might have experienced the last earthquake of a 7.8 magnitude on April 25, 2015, in Nepal which epicenter was in place A and caused serious damages and killed several people and other lives. Earthquakes can happen frequently and anytime (minor or major earthquakes). Now, your and your team's job is to determine whether or not another earthquake of a 10.0 (or double 15.6) magnitude could ever happen in the place B. While doing this project, predict the epicenter; discuss the potential impact on people's lives, place's infrastructures, economics, education, etc. Gather the information/evidence by talking to higher authorities or more knowing others (or people in the community) or use technologies to explore the facts and solutions (how to minimize the impacts on life and environment). Also, come up with some models or representations (pictures, paintings, etc.) to portray your creative imagination of the future which is/are useful to minimize the impact of the earthquake. Moreover, create a model of earthquake resistant village or city (including the design of homes).

Thus, this might be one example in which students can be engaged in project-based or problem-based learning scenarios by interacting the world around them that integrates concepts and skills of multiple disciplines, problem-solving approach through real-world application experiences, and essential 21st-century skills, including metacognitive and creative imagination skills. Here, the emphasis is on the problem-based centralization of curriculum as Beane (1995) discussed that curriculum integration begins with the idea that the sources of curriculum ought to be problems, issues, and concerns posed by life itself wherein concerns generally falls under self or personal and issues and problems posed by the larger world. In this case, interdisciplinary and transdisciplinary approaches seem to be appropriate. In doing so, we are not against of multidisciplinary curriculum integration because it could be the starting point of shift in education.

STEAM curriculum could be locally and contextually designed based on the guidelines provided by CDC under the ministry of education. Thus, the guidelines can be crucial framework for developing curriculum synergistically by teachers together with students and members from community. In this regard, the curriculum now might have become the representation of the balanced nature of local and global perspectives (a Glocal view); modern and traditional knowledge systems; depth and breadth; knowledge skills, characters, and meta-learning, outcomes, process, and praxis; and the mind, the body (including heart), and the soul. While doing this, the curriculum appears to be the portrayal of the needs of local people, student-centered, and adaptable based on the emerging evolutions in the world. The adaptable nature of curriculum seems to be flexible and a living document or framework of learning based on what the world is becoming, what it needs, and the best ways to achieve our individual and collective goals through education (Fadel et al., 2015). With this nature of the curriculum, it appears to be able to include potential breakthroughs in the world such as technology; to address students' needs, interests, and personal growth goals; and to explore outside the school environment for creating diverse learning opportunities for learners for deep and rich learning experiences.

Another focus of STEAM curriculum should be the value of ecological consciousness which might be one of the fundamental elements of holistic education (Nakagawa, 2000). This probably gives rise to the basis for knowledge systems arising from local cultural practices of people. Zhang (2006) considers the notion of ecological consciousness as 'acknowledging the rightful co-existence of humans and the non-human aspects of nature, thereby realizing inseparable relationships between nature's different forms of lives' (as cited in Luitel, 2009, p. 297). This might be necessary to promote Nepali Cultural Worldview offering a basis for viewing, knowing, valuing, being, imaging, imagining, and envisioning the importance of co-existence. For instance, Luitel and Taylor (2005) argued that the primary notion of contextualization of mathematics curriculum is to ensure the inclusion of local knowledge traditions as the curriculum content. As we know our multicultural society is more likely to respect all the existences of the world, considering one existence is interdependent and inseparable from the existence of the other. In this view, the curriculum could be inclusive and empowering for the culturally contextualized education that helps us incorporate local knowledge wisdom traditions arising from everyday cultural practices of people.

REFLECTION AND LESSON LEARNT

The disempowering and conventional nature of the existing curriculum serves the technical interest of human thereby emphasizing on textbook-based problem algorithmic problem solving, memorization and rote recall, lower-order thinking abilities which are some of the reasons of dissatisfaction and decreasing interest of people in education. Considering curriculum as a subject matter to be taught, as a collection of discrete tasks and concepts, and as a reproduction of knowledge is being unhelpful to produce skillful, aware, and creative human being who can be agents of change for society. The disciplinary and compartmentalized nature of curriculum and instruction is not allowing students and teachers to think beyond the disciplinary boundary for exploring the connection of academic contents and the real-world. However, in the context of reforming and transforming nature of curriculum as discussed by Schubert (1986), such as curriculum as experience (building knowledge and skills based on students' prior rich knowledge and experiences), as social reconstruction (building awareness to make an equitable and inclusive society through empowerment, freedom, and autonomy), as currere (learning from critical self-reflection) are being helpful for the quality change in society by transforming the values, skills, and knowledge to students. So, STEAM education is grounded in, but not limited to, in these three curriculum images.

As far as holistic and constructive models of education are concerned, education should foster the required knowledge and 21st-century skills among students so that they can solve the complex problems available in their surroundings, day-to-day life, or the world. For this, the integrated knowing and knowledge of more than one field are necessary conditions to research the problem holistically and solve them because the problems faced by people and other beings in the world are complex and interconnected. STEAM education is grounded in the concept of integrated learning promoting science, technology, engineering, and mathematics in education, and they can be learned effectively and in a fun way through arts-based methodologies such as storytelling, sculpturing, poetry, singing, dancing, painting, etc. Similarly, for the continuous innovations to make life easier in this world and maintain ecological sustainability, students must be exposed to learning experiences having rich hard skills, higher-order thinking skills, transformative sensibilities (critical consciousness, ecological consciousness, metacognition), and affective dimensions related skills. This seems to be possible with the transdisciplinary nature of an integrated curriculum.

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