CRAFTING CULTURAL INTELLIGENCE IN SCHOOL MATHEMATICS CURRICULA: A PARADIGM SHIFT IN NEPALI SCHOOL EDUCATION

CONSTRUINDO A INTELIGÊNCIA CULTURAL NO CURRÍCULO MATEMÁTICO ESCOLAR: UMA MUDANÇA DE PARADIGMA NA EDUCAÇÃO ESCOLAR NEPALESA

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ABSTRACT

In this article, we have used a *Cultural Project-Based Learning* (CPBL) to both challenge the way schooling views the sociocultural existence of the learners and try to transform the way we teach mathematics. CPBL has been taken as an alternative way to empower learners by engaging them in socially and culturally authentic problems and projects in order to understand the mathematics that used to be taught in isolation. Thus, we have raised issues of schooling itself and questioned its *neocolonial* goal of *cultural genocide* through education. Likewise, we share here one fieldwork example of how to empower teachers with a critical consciousness for teaching and learning process in an authentic context as well as for excavating vested interests in a way that could empower learners by utilizing their *cultural intelligence* so that their confidence and self-esteem can be enhanced. However, this is not possible unless teachers are empowered to understand the notion of education as a political act. In this paper, we have described some attempts to fulfill the higher objectives of ethnomathematics that are necessary for the development of harmony, peace, and social justice in Nepal.

Keywords: Cultural Project Based Learning; Cultural Confidence; Cultural Intelligence and 21st Century Education; Ethnomathematical Shift.

RESUMO

Neste artigo, utilizamos um projeto denominado *Cultural Project-Based Learning* - CPBL (Projeto Baseado na Aprendizagem Cultural) para desafiar a maneira como a escolaridade vê a existência sociocultural dos alunos e para tentarmos transformar o modo como ensinamos matemática. O CPBL foi realizado como uma forma alternativa para empoderar os alunos por meio de seu engajamento em problemas e projetos social e culturalmente autênticos, que visam auxiliá-los no entendimento da matemática que

costumava ser ensinada de maneira isolada. Assim, levantamos questionamentos sobre a escolaridade e questionamos a sua meta *neocolonialista* de *genocídio cultural* através da educação. Dessa maneira, compartilhamos aqui um exemplo de trabalho de campo sobre como capacitar os professores com uma consciência crítica para o processo de ensino e aprendizagem em um contexto autêntico, bem como para escavar os interesses investidos de uma forma que poderia empoderar os alunos por meio da utilização de sua *inteligência cultural* de modo que a sua confiança e autoestima podem ser melhoradas. Porém, isso não é possível, a menos que os professores sejam capacitados para entender o conceito de educação como um ato político. Neste trabalho, descrevemos algumas tentativas para cumprir os objetivos mais elevados de etnomatemática, que são necessárias para a harmonia, a paz e a justiça social no Nepal.

Palavras-chave: Projeto Baseado na Aprendizagem Cultura; Confiança Cultural; Inteligência Cultural e Educação para o Século 21; Mudança Etnomatemática.

1. Introduction: Sharing a Unique Cultural Landscape

With the human evolution in different stages and in diverse locations, people in all parts of the world have created their own way of solving personal and social issues in their own often truly unique ways. Some of these became so efficient and unique while some remained temporary. With different ways of looking at their world, they created different worldviews and ways of solving social problems (Gay, 2000). Those life styles have been gradually repeated and became the foundations of the culture of their societies in both psychological and social experiences. This similar pattern has created and is still creating cultures around the globe according to their own sociocultural environments.

From the pre-hunting ages to the present date, the way we have all come to live and learn has become the shared sociocultural heritage that has an enormous impact on the way we interact, live together and solve problems in our life (D'Ambrosio & Rosa, 2008). In this regard, how Nepal became what it is becoming and what it would be is significant for educators here in order to understand how our students learn better and how this cultural notion can help our educators to understand our students from a cultural perspective. In coming to see this connection, we further see and understand the interactions between dominant classes and cultures in this part of the world.

On the other hand, exploring our dominant belief systems, Hinduism and Buddhism, is a different task. As with other religions, Buddhism and Hinduism have evolved, developed and changed over the centuries throughout Asia, and increasingly worldwide. For the past three thousand years, both religions prospered in the region of Nepali territory and produced a powerful artistic and architectural fusion. With its own development, Hindu culture has contributed significantly to the development of Nepali culture, which is observed in current science, mathematics, philosophy, and culture. Thus, our worldview is shaped by and connected to the unique sociocultural and the religious context of Nepal. Between 1500 and 1800, another cultural episode happened in Nepal in which the mixed and outstanding cultural traditions of the *Newars*[1] manifested in their unique urban settlements, buildings, and architectural structures with

[1]The Newars are one of the particular cast of Kathmandu Valley, in Nepal. They developed their own unique historical and cultural nature and claimed to be the creators of their historic civilization.

intricate ornamentation displaying prominent craftsmanship to work with bricks, stones, timbers, and bones.

It would not be an exaggeration to say that in the lap of the Himalayas, the highest mountain range of the world, lies Nepal with immense natural and cultural variation from the Terai[2] to the top of the Himalaya, and with a remarkable diversity of around 125 languages and cultures. The beauty of Nepal lies in the persistent harmony between its multiplicity and cultural plurality. The capital city, Kathmandu, has a wealth of mythological magnificence with temples that create harmony between Hinduism and Buddhism in which pilgrims show respect for, and reflect together in, harmonious coexistence. It is important to highlight that both religions share some of the same Gods and Goddesses as well.

Religion played a pivotal role in Kathmandu's rapid development as *Swayambhu Puran* reveals the hill where the *Swayambu Stupa* sits, and where lotus plants with beautiful lotus flowers once bloomed. Another written history of inscription at *Changu Narayan Temple* shows that the beauty of art and architecture has been developed over a very long time. The architectural development of Kathmandu Valley started in the medieval period when *Malla Kings* began ruling the valley. The three Malla Kings of the three states in the Kathmandu Valley – Kathmandu, Bhaktapur and Patan – filled their cities with numerous temples, palaces, and monuments constructed mainly in the *Shikhara*[3] and *Pagoda*[4] styles.

This unique cultural combination has been passed down generations and has a profound effect in the way we understand our sociocultural environment (D'Ambrosio & Rosa, 2008). Researchers studying cultural intelligence revealed that the success of the person no longer depends on the Intelligence Quotient (IQ) or knowledge of any other kind rather it is profoundly depended on Cultural Quotient (CQ) (Livermore, 2011). This truth is even greater if one enters the classroom as a teacher and becomes a facilitator of one of the most diverse corners of a society where almost all have their own unique way of learning and viewing the world (Molina, 2013). In this context, cultural intelligence is considered as a person's capacity to function effectively in culturally diverse settings. It also focuses on the ability to grasp, reason, and behave effectively in situations characterized by cultural diversity. Hence, it is a sense of an individuals' aptitude or ability to view, perceive and behave effectively in the context in which learners develop before they even come to the classrooms (Ang et al., 2007).

Hence, one of the aims of this paper is to explore both the possibilities of expanding and using cultural intelligence as well as using this same cultural heritage as mathematical learning site that is important for the development of meaningful learning in order to facilitate the exploration of social and cultural identity. We also describe how we have

[2]The Terai is a plain landscape south of the outer foothills of the Himalaya, in Nepal. It lies at an altitude of between 67 and 300 m and comprises more than 50 wetlands.

[3]This Shikkara style is a tall curvilinear or pyramidal tower whose surface is broken up vertically into five or nine sections. The final section consists of a bell shaped part of the top. Retrieved from http://www.thamel.com/htms/architecture.htm.

[4]The Pagoda style refers to multi-roofed structures with wide eaves supported by carved wooden structures. Windows, either latticed or grilled, are usually projecting, while the roof is generally topped off by triangular spires enclosing an inverted bell of stucco or burnished gold. This style shows the finest specimens of the architectural genius of Nepal. Retrieved from http://www.thamel.com/htms/architecture.htm.

orientated teachers towards the *Cultural Project Based Learning* (CPBL) and how they are mindful about this process and its consequences in the meta-cognitive level of the students in the teaching and learning process. The whole process started from the workshops for teachers in the schools in Nepal.

This article is helpful for those interested in culture and mathematics, or more specifically ethnomathematics, used to explore their own cultural significance in terms of mathematical knowledge. This paper would be a pedagogical source for those who are teachers, educators and researchers and who are searching the teaching and learning process as it relates to mathematical knowledge in the setting of their own cultural and historical context. It is important for those who are looking at cultural relevant pedagogy to help learners utilize their own cultural intelligence in order to make a better sense of what they are learning in their own sociocultural contexts.

2. Understating Current Mathematical Schooling in Reference to its Historical Presence

The history of Nepali mathematics cannot stand apart from the history of mathematics and mathematics education in the world. The history of India and Nepal cannot be separated in many cases as these territories have overlapping cultural exchange such arts, science, and other forms of knowledge. Fundamental questions that have very little research in Nepali mathematics are related to what contributions were made by Nepali mathematicians to develop current mathematical knowledge. An exception is the contributions made by Gopal Pant[5] in around 1883, which is related to the determination of cube roots and the writing of the first mathematics course book in Nepali language (Jha, Adhikari, & Pant, 2006).

The deep exploration of the history of mathematics in Nepal is not the scope of this paper. However, relevant to the research here is that most of the contributions in mathematics made by Nepalis, especially in more complex and abstract concepts, are related to the early development of astrology. The history of mathematical knowledge as it was developed in Nepal does not seem to be explored in detail, yet it has not been mentioned in the main stream of history of mathematics of the world, there are a number of rich and unexplored and unknown cultures that are left to be studied from the perspective of ethnomathematics (Neupane, 2016). According to this context, this paper attempts to explore some of the rich aspects of the mathematics related to the *Nepali Siddhi Laxmi* temple in Bhaktapur, and answer questions related to the *what, why, where, when, and how* from multi-dimensional ways, by ensuring that the pedagogical implication of the discussion would come along.

Thus, we are going to explore the *Siddhi Laxmi* temple from its history up to this date and show how we created school projects so students of different levels will continue go there and discover important aspects of mathematics and culture. This paper provides an example for developing cultural perspectives in relation to this temple that we found will help students learn mathematics and engage them in further real world collaborations. However, the problem began in the way we perceive the notion of curriculum. In Nepal, curriculum is designed in a central level since the government through the *Curriculum Development Centre* (CDC) guides its development. This center

[5]Gopal Pant was the first well-known mathematician in Nepali's History of Mathematics.

develops curriculum by adhering to its own standard process in order to determine national goals to level, subject, and content goals. CDC also ensures what kinds of pedagogical strategies and materials are needed to teach content areas as well as how to evaluate them during and after the learning process in order to reach the expected learning goals.

In Nepal, we have found that curriculum may have relevant goals and content, but how far the foundation for such curriculum stretches is relevant as well. The issue of central curriculum itself is becoming questionable in time when academia is bringing results though research on a local curriculum developed in schools and even its elaboration by the teachers, which have a foundational goal to individualizing learning to address the need of learners by applying differentiated instruction and technology. The reality of the *Curriculum Development Centre* is that it is largely technical (Luitel & Taylor, 2007), because its standards rely on a mass control system, which is guided by a one-size-fits-all *blanket approach* rather than an individualized system.

The *blanket approach* assumes that all students are equal and homogeneous, and that all schools and communities are the same. Thus, teachers use only one method of teaching and the same assessment techniques for all students despite the unique and diverse differences and that they all learn differently as they have unique geographic, religious, biological and cultural intelligences and live in distinct sociocultural contexts (Luitel, 2013). Therefore, some questions were raised: a) How far would the blanket approach serve the purpose of schooling? b) How would it determine the need of each individual and even further, how would it address the skills and abilities necessary for the 21st century such as collaboration, critical thinking, communication, and creativity with technology? (Friedman, 2007), and c) How would the educational system answer these questions so that education becomes relevant and meaningful for every learner?

In this regard, the model of schooling, which was imagined in the industrialized era, is still the guiding principle of most countries around the world. Nepal is no exception. In Nepal, the most common determinant of the learners is their age. We separate them according to their age and grade. We even call them a *batch,* as if they are something like a company product that has its own batch number. Control remains at the center of the curriculum, where planning is in the context is what teacher *does*. However, that planning is becoming more content planning rather than a learning experience. The use of technology is far from the reality for many students and teachers, and the dominant instructional technology is *chalk and talk* method. The ground principle is the *banking approach* of education (Freire, 1970 cited in Neupane, 2012) largely based on the principle of behaviorism. Recitation and memorization are at the center of instruction and repeating those facts and figures through paper and pencil is what most of us understand as evaluation (Jacobs, 2011).

3. Teaching Mathematics by Applying Culturally Relevant Pedagogy

It is important to mention once again, that Nepal, a tiny country, is made up of numerous multicultural and multiethnic communities, which contributes, as well, to diversity modes in the teaching and learning processes of the population. Because children learn better in their own contexts, the different religions, cultural practices, geographies, castes, ethnicities, languages, and histories contribute to the learning process. Nepal has a national curriculum framework, which demands specific skills,

behaviors, and knowledge for all children. At the same time, Nepali children, like children everywhere, have their own ways of doing and learning. Moreover, living in highly diverse contexts, such as Nepal, is highly dependent on cultural practices.

In Nepal, a unique or standardized teaching process has not been able to address all the expected learning achievements. This problem has suggested that *culturally relevant pedagogy* (Ladson-Billings, 1995) can play a role in the teaching and learning of mathematics. Culturally relevant pedagogies help teachers to make mathematics learning contextual and create activities where students can easily relate to their own culture and everyday life. In order for teachers to implement a sense of cultural connection, they need knowledge of and respect for the various traditions and languages in their communities (Rosa & Orey, 2011).

Thus, it was necessary for us to ask: *How can we make mathematics teaching and learning processes more relevant with the application of cultural practices and realities by using students' prior knowledge?* In developing this project, we raised a number of questions: How might we assist students to become multidimensional thinkers, rather than linear thinkers; How can we empower and encourage students to seek mathematics in their everyday life; How does cultural practices make mathematics meaningful, and if this can happen, how does it make school mathematics meaningful to our students? It was found that culturally relevant pedagogy and ethnomathematics might allow us to develop solutions.

Irvine and Armento (2001) suggested that a culturally relevant pedagogy allows teachers to provide and use meaningful learning materials; create environments, which include cultures, customs, and traditions that are different from their own; and include lessons that assist students in making meaningful connections between their lives and school-related experiences. In a culturally relevant mathematics pedagogy, teachers construct bridges between the home culture and school learning of their learners, where it can promote the student background, experience and knowledge. In this case, culture provides a natural means for students to access a framework for their own conceptual understanding of mathematics.

As a biological species, humans are defined in terms of their cultural participation (Harding-DeKam, 2014). In this regard, human development is a cultural process (D'Ambrosio, 2010). Therefore, culture is one of the most important resources for teaching and learning of mathematics (Rosa & Orey, 2013). Teaching through cultural aspects increases conceptual understanding. Ladson-Billings (1995) described culturally relevant pedagogy as a pedagogy that empowers students intellectually, socially, emotionally, and politically by using cultural referents to impart knowledge, skills and attitudes.

If a form of culturally relevant pedagogy is used in classrooms, it can help to develop a student's whole personality (intellectual, social, emotional, and political). It focuses on and relates to the prior knowledge of mathematics in the classroom. From this point of view, students come to find mathematics in their everyday life, they feel mathematics as flexible, that it increases their conceptual understanding, and come to solve mathematical problems. If teachers are aware of the cultural context of their students, they will encourage the understanding of mathematical concepts.

4. Working Perspective of *What and Why* Ethnomathematics

According to the Brazilian scholar D'Ambrosio (1985), *ethno* relates to ethnic, national, racial, religious, or professional groups. It can be a group with a similar philosophical or ideological basis, a sociocultural group and a group of people based on gender or sexual identity. *Mathema* means explaining, understanding, learning, and dealing with reality; and *tics* is a modified form for techno, which stands for techniques to solve problems. Thus, ethnomathematics relates to distinct modes of explaining and coping with reality in different cultural and environmental contexts. Hence, D'Ambrosio established ethnomathematics in the 1970s, which became a worldwide program (Rosa & Orey, 2013). These working definitions have helped readers to ask better questions in regards to why we are so excited to use this perspective in teaching, learning and research in mathematics education.

As the project grew, we continued to raise issues blending the answers of why, the participants believed that mathematics classrooms have been dominated by the *Eurocentric*[6] view of mathematics. This approach makes it appear as if *real* mathematics is a solo product of one particular culture, maybe because of which most of the students in the classroom perceive mathematics as an *alien* subject given by anonymous, forced by law as a compulsory thing to buy although students do not want it (Meyer, 2010). *How could we change the general image of mathematics and question the hidden images of mathematics so that learners could see their image and integrate their culture into both the learning process and the product of mathematics? How could we help learners build cultural confidence?*

The grand narratives created by *Newtonian* and *imperialistic perspectives* in mathematics education homogenize the micro-cultures of school. Creating alternative teaching and learning processes to empower learners culturally and ask questions on their *self* and *social identity* are the important aspect of an *ethnopedagogy* that gives students the 21st century skills as tools to ask better questions, collaborate, and reflect critically on their own *identity*. In our point of view, *ethnopedagogy* can be described as the utilization to the sociocultural context of the learners in order to assist them in the process of learning mathematics. It is the connection of ethnomathematics and culturally relevant pedagogy as described by Rosa and Orey (2013). It focuses not only on the need for teachers to value diverse home cultures of students they teach, but to explicitly address the home culture and students' understanding of it in the classroom context. Teachers are able to teach mathematics in a culturally appropriate manner situated within students' funds of knowledge (Moll et al., 1992 cited in Rosa & Orey, 2013).

We found that as Rosa and Orey (2013) suggest that this kind of pedagogy allows teachers to provide and use meaningful learning materials; create environments, which include cultural traits[7], customs, and traditions that are different from their own. It also includes the elaboration of lessons that assist students in making meaningful connections between their lives and school-related experiences. An ethno-based

[6]We choose to describe it as a form of *mathematical imperialism* that has invaded the cultural contributions and knowledge that still may be in practice in many cultural groups.

[7]Cultural traits are related to the appreciation of the unique features developed by the members of a specific culture such as its bureaucracy, religion, language, government, customs and traditions, social organization, and arts as well as the establishment of relations between the members of that group (Rosa & Orey, 2015a, p. 136-137).

pedagogy allows students to develop their meta-cognitive process, because they are able to think about thinking. This approach may help them to understand and control their own cognitive performance by encouraging them to take charge of their own learning (Flavell, 1979). It also involves am awareness of how they learn, an evaluation of their learning needs, generating strategies to meet these needs and then implementing the strategies (Hacker et al., 2009).

By applying ethnopedagogy, we have assumed that is necessary to expand the limitations of the project-based learning as a tool to empower learners to understand the meaning of what they are learning in mathematics as well as to explore their sociocultural identities.

5. Cultural Project-Based Learning (CPBL)

Project-based learning has proven its strength in diverse setting in various cultures around the world (Chakrabarty & Modamed, 2013). The issue we have raised here is: *How would we better serve the learners not just meaning making process, but also an identity though project based learning?* The critical reason of raising this voice is that education is always a political act (Luitel, 2009). In this regard, we cannot limit ourselves by questioning the vested interest of educational process by just being romantic about its positive side.

The majority of Nepali mathematics teachers we work with need to learn how to address their students' voice (Sharma & Neupane, 2014). A majority of these teachers are still teaching skills and drills in ways that serve only a select set of students (Confrey & Kazak, 2006). In this context, we have elaborated a series of workshops for teachers. The discussion in the workshops were about *ethno-projects* and helped teachers to think ou of the regular routine of *chalk and talk* and expand their horizon to the level where they themselves create the draft of ideas that could potentially become engaged in projects with their students.

Projects have a component of integrating authentic context and real world problems (O'Neill & Jelley, 2014), however, they can miss the sociocultural notion of teaching and learning as well as they may not always be culturally relevant. In this regard, we have proposed the notion of *ethno-projects* that may help teachers to vision learning in authentic real world issues in socio, cultural, and historical contexts. According to Naveira (2005), ethno-projects help to increase demonstrations of ethnic identity of the members of different cultural groups. The beginning of the elaboration of the projects was not as it was planned.

The creative tension and debate on: *Why do we need to do projects?, Why should we take students out of the school?, How to complete the syllabus?, Do teachers take the curriculum as a syllabus?,* and *Is it just a subject or inter-subject project?* The debate took a long time to reach into the level of understanding that is needed for embracing the power of introducing learners to real world problems utilizing their own social and cultural intelligence as an asset. The shift of the teachers' belief system, and empowering them became one of the key outcomes of the workshop series.

The students answered questions gradually when we visited the field together. We both applied *cultural scaffolding* that allowed them to rethink the narratives and the

neocolonial effects they have experienced regarding the culture around them. Scaffolding was used here to support instructional development in order to facilitate teaching and learning processes when students were introduced to new contents (Vygotsky, 1978) as well it needed to be directly related to the cultural background of the students. In this regard, the teachers needed to engage in constructivist cultural scaffolding in their teaching practices. In this context, cultural scaffolding means that teachers must use the local culture and their own rich community contexts and experiences to facilitate and use it to improve academic and intellectual achievement (Gay, 2000) of their students.

School mathematics needs a vision that concerns with *mathematical literacy* that provides skills and abilities necessary for the local and global citizenship in order to develop competencies to perform a *two-way border crossing* (Sharma, 2012). Hence, mathematical literacy is the collection of abilities that students gain that allows them to conceptualize, generalize, and use information based on their own investigations as well as to model complex real-world problems. Hence, students learn to use a diversity of information sources and representations to facilitate transpositions between those sources in order to develop new approaches and strategies to deal with these problems. This approach plays an important role in the development of active citizens and their democratic sense because helps the development of their mathematical, technological, critical, and reflexive knowledge. This approach allows mathematics to be used as a tool for students to interact with their community, and it becomes a form of action (Rosa & Orey, 2015b).

5.1. A Paradigm Shift: Changing the Notion of CPBL

We have been using projects to help students learn in authentic contexts in order to develop their 21st century skills and provide meaning to the mathematical contents they are learning (Ravitz et al., 2012). However, in our point of view, this type of project-based learning has its limitation because it cannot account for all social and cultural contexts and it cannot provide answers to questions: a) *Why are they learning?* and b) *Can they be vulnerable to the use of any form of neocolonial act*? It is necessary to highlight here that neocolonialism in education relates to the "inappropriate wholesale adoption of western educational theories and practices" (Nguyen et al., 2009, p. 123). It is also important to highlight here that there is a "potential for mismatch when educational approaches are transferred across cultures without sufficient consideration of the norms and values of the host society" (Nguyen et al., 2009, p. 123-124).

In this regard, we attempted to answer these questions to show how this kind of learning contributed to the development of meaning to the mathematical knowledge in order to enhance the use of the sociocultural context of the students and give them sense of their own identity. This approach helped students to raise their consciousness towards education as political acts (Freire, 1970). In this context, it appeared that the process of project-based learning was tactically detached in relation to the learners' sociocultural context and resulted from traditional educational methods such as traditional chalk and talk methodologies. However, in its philosophical ground, this approach is in accordance to core objectives of the educational system, as it does not account for the sociocultural context of the students since it has a vested interest to homogenize diverse group of learners. Thus, this approach has helped to develop *sameness* since people can be like robots that perform in similar ways (Godin, 2014).

Similarly, the prospects of many ethno-projects provide two significant meanings: one is to provide a sense of identity to the students and their cultures and develop cultural confidence though cultivating cultural intelligence and the second one is to critically examine and even challenge the vested interest of the education system and create new foundations that accounts for the sociocultural contexts of learners. Which is important to set beliefs of teachers, teaching process and even to create system that believe in harmonic existence rather than homogenization (Luitel, 2013). This perspective provides a space for critical discourse for educators and formed the base to the program we developed for pre and in service teachers' preparation. In addition, as researchers, we developed new perspectives to view the educational contexts of the teachers we were working with, and learned to give critical power to teachers to examine their own beliefs about teaching, learning and the learners.

The framework of this project acknowledged the global culture of learning as well as its local connection as it demands a creative adjustment in the teaching process that occurs in the system that currently exists, which is not sufficient to address the sociocultural needs of the students (D'Ambrosio, 2001). Therefore, it is necessary to take an account of the development of the mathematical development, which needs to be critical in relations to its purpose of creativity and innovative shift towards a more inclusive teaching and learning framework described as an *ethnoshift*. Figure 1 shows a framework for the development of project-based learning in relation to the students' sociocultural contexts.

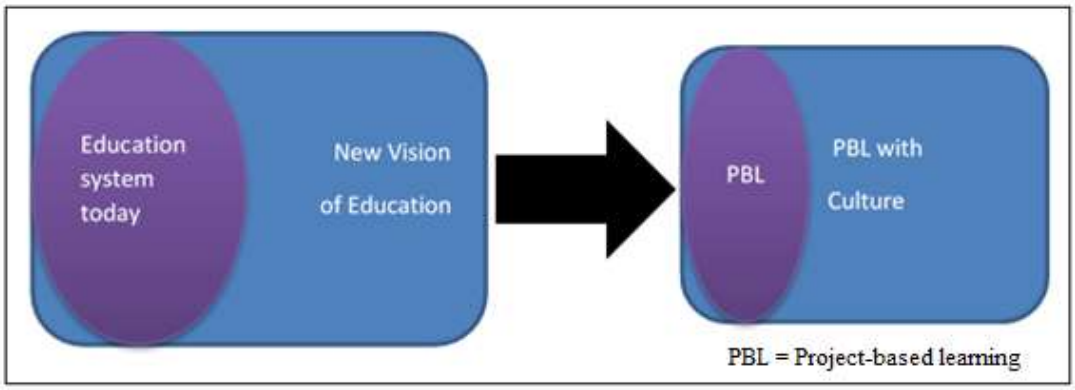

Figure 1: Framework for the development of project-based learning in relation to the sociocultural context of the students

We may not be able to do justice with culture of our students without accounting it unconsciously. Our task was to narrow the expectations of society and culture in regards to pedagogical experiences we are providing as we empower teachers, learners, and learning agencies to become consciously critical of the nature of cultural genocide (D'Ambrosio, 2012) in the name of education, specifically mathematics education. Thus, when teachers become conscious of their own culture, they help their students to become aware of their own culture (D'Ambrosio, 2007). As well, the notion that there are no superior and inferior cultures, rather that all cultures are unique in nature, allowed the teachers in this project to become more tolerant, democratic and contribute in to the social peace, inclusion and justice.

It would be better to examine ontological and epistemological versions of educational objectives (Luitel, 2013). Epistemological is used here in its broadest sense to refer to a

theory of knowledge and rationality (Feldman, 2003). Thus, epistemology can be defined as being "concerned with the origin, nature, limits, methods, and justification of human knowledge" (Hofer, 2000, p. 4). Ontological is applied in its broadest sense to refer to the nature of reality and being (Mertens, 2005). In this context, one of the objectives of education is to pass cultural wisdom to the next generation (Fien, 2010). Nevertheless, the way educational process happens, often leaves very little space for the culture of the students and their community.

The traditional educational process has used advanced *neocolonial* weaponry (i.e. educational objectives) as the *hidden curricula of colonialism* (Luitel, 2009). This is far more lethal than any other weapons used to silence the masses and create cultural genocide (Hampton, 1995). Neocolonial curriculum is often based on:

> Cross-cultural cloning, increasingly fuelled by western-oriented globalisation, may result in academic ineffectiveness, serious neglect of cultural assets, weakening of the host culture's own research capacity and at the same time, may help to perpetuate a sense of dependency on the part of formerly colonised host cultures (Nguyen et al., 2009, p. 124).

In this regard, our project attempts to challenge this version of the educational process in order to empower both teachers and learners regarding to their culture in order to defend their own cultural heritage from this mass genocide. This project is not just about how to organize projects in school, but also to the educational process. This led us to fundamental discussions related to the version of education we are expecting from the current education system. *How to make an educational system accountable to all culture? How to empower students to become better learners in their culture and in the culture of others through collaboration? How to help learners expand their cultural intelligence to become culturally creative? How to promote social justice and inclusion though education?*

These fundamental questions and issues need to be discussed before we accept education as it is today, which gives rise to paradigm shifts, which we call an *ethnoshift* of education as mentioned in figure 1. In our point of view, *ethnoshifts* are paradigm shifts in classrooms pedagogical action towards more inclusive teaching and learning processes and where the sociocultural experiences of the learners are respectfully brought into the classroom discussion (Rosa, 2010). It is also represents a philosophical shift in education and "means that the non-west has to create a whole new body of knowledge, rediscover its lost and suppressed intellectual heritage, and shape a host of new disciplines" (Sardar 1999, p. 57).

Every learner is intelligent in various forms as described by Gardner (1983). However, everyone is *culturally intelligent*, and like any intelligence can be improved. We learn better if learning is connected with our own experience and cultural context. Learning becomes more meaningful to the individual and offers a sense of identity (Neupane, 2016). Cultural intelligence has been used here in two senses. One is to provide ample space to *re-discuss* Gardner's idea of intelligence from the perspective of learners' sociocultural context and identity. *Does Gardner account for non-biological diversity? Does Gardner provide space to account learners cultural context and even account learners cultural intelligence? Does Gardner challenge the interest of homogenization that is depicted into the DNA of education system?*

There is little doubt that Gardner has given space for diversity, but not directly from the perspective of the culture and identity of learners. In his assumption, the *sociocultural* is kept silence, if not dead. His idea could not offer much alternative to the people who are searching their image in the education process and fighting for their social, cultural, and self-identity in the curriculum to the learning process. Figure 2 shows an inclusive diagram of a learner's intelligence. In this diagram, the use of non-biological intelligence is related to our idea to challenge Garner's version of intelligence, which just accounts for the biological intelligence. The term *non-biological intelligence (NBI)* is used in artificial intelligence (Godfrey, 2011).

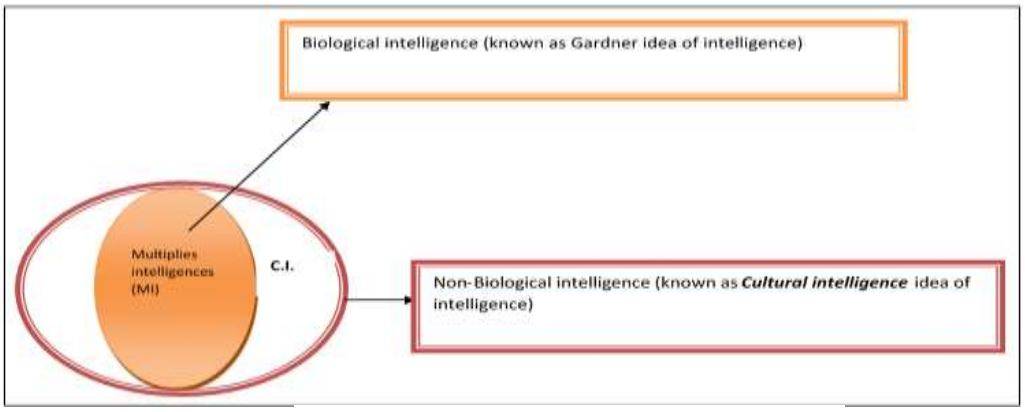

Figure 2. Inclusive diagram of learner's intelligence

This discourse led us to the next step in the development of our project, and provided a critical perspective even to view the so called intelligence and challenge to our own way of perceiving Gardner's idea of intelligence and offers a new perspective in Nepal.

5.2. CPBL: Students' Projects

At our project schools, teachers felt uncomfortable, and were unsure about the temple project, so we proposed a visit to the field. Thus, we set a date and time to visit the square and we met near a *Krishna Temple*, which is near the school, and together we designed the project further. The group did not comprise only mathematics teachers, but also social studies, English, Nepali, and computer teachers. Together, we observed the temple for over half an hour, and we discussed how we could go forward and began to answer some of critical questions like: *Which level of students should be brought here?*, *What would be the students' roles?*, and *How could it connect to the curricular objectives of more than one subject area?*

One of the teachers proposed that we needed to extend this project for other classes and in other areas as well. He further proposed to visit *Bhaktapur Darbar Square*[8] and *Basantapur Darbar Square*[9]. During this discussion, a mathematics teacher raised a question: *What would be the end product of this project?* A science teacher proposed to create a scale model of the temple with its history (social study), measurements for scale model (mathematics), report writing and essay (English and Nepali), and experiment of the stone and acid effect on stone (Science). In the meantime, computer teachers proposed the creation of applications of the temple.

[8] https://en.wikipedia.org/wiki/Bhaktapur_Durbar_Square.
[9] https://en.wikipedia.org/wiki/Kathmandu_Durbar_Square.

After we worked in the workshop and pre-visited the temple together, teachers drafted possible questions and basic structure of the project and dated the field visit day. During the pre-visit to the temple, teachers requested students to work first in a group according to their mathematical content and after finding what they could do with and how curriculum objectives would be addressed. Hence, teachers developed a holistic picture of the project.

In the visiting day, after orientating students, teachers divided them into five different groups with 6 students in each in order to help them to develop collaborative skills. After talking to the group of students, teachers presented the projects related to the *two temples* in different places, *Patan* and *Bhaktapur*, and asked the groups of students to choose their project. During the development of the projects, students had collected historical information and measured the area of the base of the temples of *Siddhi Laxmi Temple* in Darbar Square in Bhaktapur and *Krishna Temple* in Patan. They answered the questions given by the teachers based on their observation of the temples. In addition, one group of students also observed a nearby river; the other group observed the shops and the last group observed the reconstruction sites[10] as part of understanding mathematics and its application in the authentic sociocultural contexts.

This context allowed students to create a model of the chosen temple. They also created applicatives in order to provide Google maps and detailed information of the temple's historical and archeological assets that are important for visitors who wanted to visit it or know more about it. However, for the purpose of this paper, we will describe one of the projects that is related to the Siddhi Laxmi Temple regarding to the discovery of the predominance of prime numbers in its architectural structure.

6. Hindu Temples and the Siddhi Laxmi Temple

Hindu temples are considered as the houses of the God(s). They are infused with symbolism to express the ideas and beliefs of Hinduism. Thus, Hindu temples are places and structures designed to bring people and God(s) together (Michell, 1988). The temples come in many styles. They are constructed in a diversity of locations, deploy different construction methods, and are adapted to different deities and regional beliefs. Almost all Hindu temples share certain core ideas, symbolism, and themes (Boner, 1990). Hindu temples are links between humankind, deities, and the Universal Purusa, the Supreme Principle, in a sacred space. They also reflect the arts, beliefs, values, and the way of life of Hindu people (Michell, 1988).

In this context, Michell (1988) states that, according to ancient Indian texts, temples are places for pilgrimage. The pilgrims are welcomed through 64-grid or 81-grid mathematically structured spaces, a network of art, pillars with carvings and statues that display and celebrate the four important and necessary principles of human life. Figure 3 shows the *Parama Sayika* mandala that is the second most common Hindu temple format set on a 9 x 9 grid.

[10]Several buildings in both squares collapsed due to the major earthquake on April 25th , 2015. Both squares are surrounded with spectacular architecture and vividly display the skills of the Newar artists and craftsmen over several centuries. For more information about the 2015 Nepali earthquake see: https://en.wikipedia.org/wiki/April_2015_Nepal_earthquake

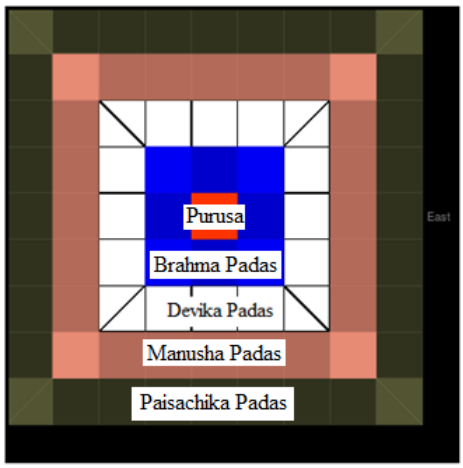

Figure 3: The 9 x 9 (81) grid *Parama Sayika* layout plan[11]

These mandalas were built as ceremonial temples by kings and regional communities. They are typically very large. In this symmetrical structure, each layer has its own significance. For example, the *Paisachika Padas* layer signifies aspects of *Asuras* and evil, the *Devika Padas* layer signifies aspects of *Devas* and good. In between the good and evil there is the layer of *Manusha Padas* that signifies human life. All these layers surround *Brahma Padas* that signifies creative energy and the site for temple's primary idol for *darsana* (sight or vision).

At the very center of *Brahma* padas there is *Grabhgriya* (Purusa Space) that signifies the *Universal Principle* present in everything and everyone (Kramrisch, 1976). These spaces are the pursuit of *artha* (prosperity and wealth), the pursuit of *kama* (pleasure), the pursuit of *dharma* (virtues and ethical life) and the pursuit of *moksha* (release and self-knowledge) (Parker, 2010).

Siddhi Laxmi temple is located at the center of Durbar Square, in Bhaktapur, in Nepal. Bhaktapur Durbar Square is one of the cultural heritage sites recognized by UNESCO in 1987, and is filled with several architecturally diverse temples. It is internationally renowned for its pottery and woodcarving. Each temple in the Durbar Square poses its' unique cultural and archeological importance following distinctively decorated carvings of wood, stones or metals. The city of Bhaktapur is known for its majestic monuments, colorful festivals, and for the native Newars and their generations of craftsmanship.

This temple itself is built, approximately, in the 17th century, in the classic Shikhara style, which is commonly seen in the north of India. It is worldwide recognized for its elegant art, fabulous culture, and archeological importance. Figure 4 shows the Siddhi Laxmi Temple, in Durbar Square, in Bhaktapur.

[11]https://upload.wikimedia.org/wikipedia/commons/7/7f/81_grid_Parama_Sayika_design_Hindu_Temple_Floor_Plan_Vastu_Purusa_Mandala_Ancient_Architecture.svg.

Figure 4: Siddhi Laxmi temple

Siddhi Laxmi temple was built of stone and is guarded by a male and a female holding a child, a dog at first and a horse, a rhino, lions and camels, respectively, in the successive platforms.

6.1. Students' Findings: Structure and Ethnomathematical Ideas in the Temple

The first observations of the temple shows that it is built in a square base with a mix of cuboid and cone shapes. In addition, there is a seven storey rising from a square base with the unique diminishing ratio of 1.4 in each pair of the storey. The temple, which lies on top of the seventh storey is connected with a staircase of 17 stairs. Each square base is constructed with 7 big and small stone slabs. Similarly, with a precise look into the base, there are 5 stones used to make the height of the each storey base. In addition, there are 7, 13, 13, 13, 13, 13 and 5 stones used to make the width of the base each storey from the base respectively. The base of the temple has two bangles in the upper and lower part. In each base, the upper part of the bangle has 31 pieces and the lower part has 37 pieces of stone.

Below, we summarize the observations made by the members of a group of students during their fieldwork at the Siddhi Laxmi Temple:

1. Number of stairs: 17
2. Number of statue in each row: 7
3. Number of slaps in each base at the upper part: 7
4. Total number of bases to reach the main part of the temple: 7
5. Number of stones used to make the height of the base: 5
6. Number of stones used to make width of the base: 2, 3, 5
7. Number of stones in each stairs: 2
8. Number of holes in one part of windows: 43
9. Total number of bents: 13

10. Number of bells: 2
11. Number of animals (tiger) used at upper part of temple: 3
12. Total number of Bengals for button to top: 31
13. Pillars used in temple: 13
14. Windows: 7
15. Number of stones in each bases in one side (from button to top): 7, 13, 13, 13, 13, 13, 5 respectively
16. Total number of statues used in a temple: 23
17. Total parts of temple: 2
18. Each part of temple has been divided in the form of: 2, 3, 5
19. Number of pieces in a bangle
    - Upper part: 31
    - Lower part: 37
    - And 47 in the upper part of each base
20. Total sections of temple: 13
21. Front sections of the temple: 3

There are 23 statues used in the temple including the main deity. The front part of the temple is divided into two parts with two bell-shaped pinnacles. Further, there are three sections: a cubical, cuboid, and conic shaped from the bottom to the top of the temple. Each section of the temple has been divided into 2, 3 and 5 parts respectively. All together, the temple can be seen in 13 parts from outside including the pinnacle. The front section of the temple can be seen in 5 parts including the pinnacle.

6.2. Reconnecting to the Culture: Numbers and their Importance in Hinduism

The question raised from the first observation was: *Why are almost all of the numbers found in the Siddhi Laxmi temple prime numbers?* In this context, it is important to understand the symbolic significance of prime numbers from the Hindu perspective and their association with some important concepts and divinities of Hinduism. It is necessary to explore how ancient Nepali people used these numbers to organize information they had about the creation and the divinities in a systematic way to arrive at a Hindu cosmology from a numerical perspective (Jayaram, 1999). Thus, these numbers offer important opportunities for teachers to mediate the teaching and learning process in the classrooms in order to help students realize the hidden symbolism of the numbers in their own sociocultural contexts:

- **Number 2 i**n Hinduism have symbolic meanings, which is named *prakriti* and *purush*, and *aatma* and *pramaatma*. This number is significant in describing the absenteeism theory, which relates the existence of one the absence of the other. For example, the presence of light signifies the absence of dark (Srinivasan, 2012). Thus, this number symbolizes *Purusha* (God) and *Prakrit* (Nature) as well as *Brahman* (the Knower) and *Atman* (the Known) as two separate entities. It is a paradox we have to solve by either attaining the one (self-realization) or the zero (nirvana) (Jayaram, 1999).

- **Number 3** represents the *Tri Runa*: S*atwa, Raja*, and *Tama*, who are the three gods of Hinduism: *Brahma*, the Creator, *Vishnu*, the Protector, and *Shiva*, the Destroyer; *Trisandhya*: three times in a day; the morning, day, and evening;

three loks in Hinduism: *satya* lok, *martya* lok, and *patal* lok. Three eyes of lord *shiva*, *trikal*: past, present and future (Srinivasan, 2012).

- **Number 5** represents the *Pancha Vaibhavas*, which are the five qualities of *Brahman* in *Vedanta*: Truth (*Satyam),* Knowledge (*Jnaanam*), Infinity (*Anantam*), Bliss (*Aanandam*), and purity (*Amalam*). There are five mantras regarding to *Panchaanana* that are related to the *Supreme Brahman*. In Hindu temples food made of five sweet things called *panchamrutam* are offered to the deities (Jayaram, 1999; Srinivasan, 2012).

- **Number 7** represents seven chakras in Hinduism, and which reflect how the unified consciousness of humanity relates to our immortal human being or the soul that is divided in order to manage differences of life on Earth such as body, instinct, vital energy, deeper emotions, communication, an overview of life, and contact to God (Jayaram, 1999).

- **Number 13** is also found in the Siddhi Laxmi temple, which represents the 13 *Visvedevas* who are Vedic Gods: *Vasu*; *Satya*; *Kratu*; *Daksha*; *Kaala*; *Kaama*; *Dhritu*; *Kuru*; *Purooravas*; *Madarvas*; *Rocke*; *Dhanvi-Dhuri*; *Brihaspati*; which in Hindu *darsan* means sight or vision (Srinivasan, 2012).

- **Number 17** relates to the seventeen *Vedic Tattvas* that are the Five elements (Earth, Water, Fire, Air and Ether) + Ten senses (*Indriyas*) comprised of 5 cognitive senses (*Jnanendriyas*) that are smelling, tasting, seeing, touching, and hearing; and 5 active expressions (*Karmendriyas*) that are eliminating, moving, reproducing, grasping, and speaking + Entire World of Activity (*Praana*) + Mind (*Manas*) = 17. These numbers have strong connections with the *Mahaanaraayana Upanishad*, which is the essence of Vedas and Vedic messages and are most popular in the Vedic literature (Srinivasan, 2012). Vedas are considered the oldest written text of human civilization and are the source of various forms of knowledge: the four earliest scriptures of Hinduism: *Rig* (Rik), *Ather*, *Samur* (Sama), and *Yajur Vedas* (Jayaram, 1999).

- **Number 23** represents the Three Sareeras, which is the Doctrine of the Three Bodies that emanates from *Brahman*. It is composed of 23 constituents: *Brahman* who created humans as a composite unit of the three types of bodies, which are the Gross body (*Sthoola Sareera*); the Subtle Body (*Sookshma Sareera*) and the Casual Body (*Kaarana Sareera*). The Gross body consists of 5 elements, which after grossification are Space, Air, Fire, Water, and the Earth; the Subtle body constitutes of 5 Organs of Perceptions (*Jnaanendriyas*), 5 Organs of Action, Five Praanas, Mind (*Manas*), and Intellect (*Buddhi*). They constitute 17 things; and the Casual Body is the sole cause of the two other bodies and is free from duality. All the three bodies together constitute 23 things. Having created them, *Brahman* has entered into the humans as *Antaryamin* (Inner-self) as the overseer (Kramrisch, 1976; Srinivasan, 2012)**.**

- **Number 31** refers to the creation of the 9 *Navagrahas* + 12 *Adityas* + 10 *Dikpalaks* by *Brahman* who assigned them to work with specific duties in the Universe (Srinivasan, 2012).

Numbers play an important role as symbols of divinities and energy for the Hinduism as it has a far-reaching spiritual and religious significance. They may serve as a mean to help students to find the importance of their culture hidden in each prime number. The world that students have experienced in the fieldwork helped them to connect aspects of their cultural background to the numbers hidden in the temple design and structure.

This approach helped students to develop their cultural intelligence as it relates to the discovery of a hidden mathematical knowledge applied in this temple, which motivated them to rediscover their own cultural background. Thus, they "mathematized time, and, through it, their religion and cosmology" (Ascher, 2002, p. 63). With this activity, students incorporated concepts of prime numbers by utilizing symbolic elements to express their ideas about creation of the temple. In this context, these philosophies related to prime numbers of their abstract manifestations in the temple were used to help them to explain, understand, and comprehend organizational principles of their own culture (Rosa & Orey, 2007).

In this context, culturally relevant pedagogy focuses on the role of mathematics in the sociocultural context of the students that involved ideas and concepts associated with ethnomathematics ideas related to prime numbers. This process of teaching mathematics through cultural relevance and ethnomathematical perspective by using cultural project-based learners helped students to know more about their own reality, culture, and society by providing them with mathematics content and approaches that enabled them to master academic mathematics (Rosa, 2010).

In this context, when practical or culturally-based problems are examined in proper sociocultural contexts, the mathematical practices developed by the members of different cultures is not trivial because they reflect themes that are profoundly linked to their daily lives (Rosa & Orey, 2014). It becomes connected to objects and places they literally walk by everyday. Thus, students may be successful in mathematics when their understanding of it "is linked to meaningful cultural referents, and when the instruction assumes that all students are capable of mastering the subject matter" (Ladson-Billings, 1995, p. 141).

According to Rosa and Orey (2013), this approach aims to draw from the students' cultural experiences in using them as vehicles to make mathematics learning meaningful as well as to provide students with the insights of mathematical knowledge as embedded in their sociocultural environments.

7. Final Considerations

In this paper, we have used CPBL to both challenge the way schooling views sociocultural existence of learners and tried to transform the way we teach mathematics. The changing notion of CPBL is an alternative approach we use to empower learners by engaging them in socially and culturally authentic problems to understand the mathematics that used to be taught in isolation. Moreover, this approach helps to promote creativity by helping students to fulfill their potentials and raise their capability to the highest, but being careful not to promote docile citizens. Thus, we do not want our students to become citizens who obey and accept rules and codes that violate human dignity (D'Ambrosio, 2010).

Further, D'Ambrosio suggested promoting citizenship that transmits values and shows rights and responsibilities in society, but being careful not to promote irresponsible creativity. In this context, we do not want our students to become bright scientists who create new weaponry and instruments of oppression and inequity. We, as mathematics teacher educators, are trying to incorporate global views of mathematics education in classroom practices in Nepal. In order to do so, we have raised issues of schooling itself and questioned the neocolonial underpinnings that have created a sense of *cultural genocide* in Nepal through education (Hampton, 1995). Shifting the paradigm of schooling into an *ethnoshift*, we have offered one field example that is able to empower teachers and students with a critical consciousness of their own cultural background.

The use of cultural intelligence of the learners helped to enhance their confidence. However, this is not possible unless teachers are empowered to understand the notion of education as a political act. Hence, we have provided a field based example showing how educators around globe are able to broaden their worldview in order to understand the schools' hidden curricula and use this notion to fulfill their own and students' sociocultural needs by nurturing and helping them to understand the political face of education.

In relation to cultural project-based learning regarding the didactical work developed in schools, the "views of pedagogy within the literature on ethnomathematics are compatible with work on culturally relevant pedagogy" (Hart, 2003, p. 42), which examines the cultural congruence between students' community and school. However, it is paramount that educators and teachers understand that cultural congruence indicates respect for the cultural background of the students (Rosa & Orey, 2015b). Educators who want to implement the principle of cultural congruence in their classrooms should be knowledgeable of the diverse cultural traditions of their students. In order to reach this goal, these same professionals must develop a clear sense of their own ethnic and cultural identities to enable an appreciation of the diversity of their students (Rosa, 2010).

On the other hand, with the longer history of human civilization, we can find the traces of mathematics along with it. The expressions or characteristics of human civilization are carved in several monuments such as the pyramid of Egypt and others. Analyzing these evidences shows that the mathematical journey is aligned with human civilization. In this regard, in the Kathmandu valley, with cities of temples, is also an important living history of civilization and mathematics. The South Asian temples have been erected to align with the philosophical grounds of Hinduism and Buddhism. These are also evidence of the civilization and origin of mathematics centuries that came before. The oldest known scriptures, the Vedas and Upanishads describe the architecture of these temples. In the aftermath of the great earthquake on April 25th, 2015[12], several features of our history are under threat and in verge of extinction.

In this regard, we find the responsibility to further capture the evidence and continue to explore the mathematical significance of our own cultural background even more urgent. This is why we purposively chose Siddhi Laxmi temple of Bhaktapur for our research. The choice of these projects is associated with our cultural myths but, remarkably, the numbers of idols, stones and the complete architecture of the temple

[12] https://en.wikipedia.org/wiki/April_2015_Nepal_earthquake.

reflect the precise mathematical calculations in this particular temple and the connections to architectural structures with prime numbers and Hinduism**.**

In closing, we have described here the importance of an *ethnoshift* from the blanket approach to the culturally relevant approach, which is a missing part in the most of the schooling today in Nepal not only because of the misguided and unconscious neocolonial curriculum but also of its uncritical acceptance. Shedding and harvesting the hope of meaningful learning processes to each individual and recognizing in each student our unique cultural background is a strong determinant for (re)conceptualizing the learning process in our classrooms.

Finally, it is our hope that we are able to further connect these factors by applying ethnomathematics, culturally relevant pedagogies, and cultural intelligence during the development of the cultural project-based learning in the classrooms in order to help students to understand the importance of their own sociocultural contexts in the process of teaching and learning mathematics in Nepal.

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