Developing Culturally Contextualised Mathematics Resource Materials: Capturing Local Practices of Tamang and Gopali Communities

A Report
The study report on “Developing Culturally Contextualised Mathematics Resource Materials: Capturing Local Practices of Tamang and Gopali Communities” was undertaken in collaboration with the Kathmandu University School of Education within the UNESCO’s regular programme on education.

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Newer experiments in mathematics have been emerging in order to make mathematics more meaningful to the children, their parents and teachers. In the past mathematics was an abstract subject clamped with long formulae and mechanical processes. The days have passed and the focus is on the meaning of what children learn and their application in day to day life. Ethno-mathematics is one of the innovative ideas in the discipline of mathematics that identifies meaning of mathematics in day to day activities and looks for the implication for life long learning. In developing countries, like Nepal, it is still difficult for the math-educators to introduce new ideas and innovation in teaching learning situation. There may be several reasons for this. The most important reason is to put the ideas forward. Once the ideas are forwarded they need to be activated into the instructional processes whether they are in formal, informal or non-formal contexts. For this financial support is crucial in order to crystallize the ideas.

This study report on Developing Culturally Contextualised Mathematics Resource Materials: Capturing Local Practices of Tamang and Gopali Communities is the result of an action-research based on the results of the field work undertaken by the Kathmandu University School of Education in collaboration with the UNESCO Office in Kathmandu, Nepal in 2006-2007. For the first time in Nepal we have been able to come up with this important piece of action oriented research and materials development based on the research itself regarding ethno-mathematics. We are very grateful to UNESCO in this regard and particular thanks are extended to Mr. Tap Raj Pant and Mr. Sergio Hoyos Ramos for their constructive contributions and dedication to working on an unexplored and challenging domain.

We would like to take this opportunity to thank the research team of the Kathmandu University School of Education for their valuable and productive work. Bal Chandra Luitel played a key role in formulating this activity and remained constantly engaged until its completion. He was so keen on this that he took the charge of finalizing the report even if he was in Australia for his further studies. Shashidhar Belbase took all the responsibilities to design and implement the idea in selected schools, prepared the materials, implemented them in schools and brought us to this point. Prof. Tanka Nath Sharma, Prof. Peter Charles Taylor, Prof. Bidya Nath Koirala, Tika Ram Pokhrel are among the key figures without whose support this report could not have been in this final shape.

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April 2008

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Executive Summary

The main objective of this project was to develop culturally contextualised mathematics curriculum resource materials for the lower secondary schools of Nepal in order to foster a culturally pluralistic society. Specifically, the project focused on the practices of women and economically disadvantaged ethnic communities – Tamang and Gopali – of Hilly regions of Nepal. Aimed at preparing curriculum resource materials for students, teachers and awareness materials for parents, the project set out to achieve the following general objectives:

- To build a knowledge base of the ethno-mathematical practices of the economically disadvantaged ethnic communities of Nepal.
- To develop culturally contextualised curriculum resource materials to supplement the existing lower secondary mathematics curriculum.
- To make local stakeholders aware of the cultural contextualisation of mathematics education.
- To enable lower secondary school teachers to develop a culture-sensitive pedagogy based on principles of cultural inclusiveness, gender equity and student-centred teaching and assessment.
- To improve student achievement and participation in mathematics at the lower secondary level.

In order to achieve the main objective, the project adopted a two-phase procedural strategy in order to develop the culturally contextualised materials for teachers and students and support materials for parents. The development phase comprised the activities of conceptualising the project, carrying out the fieldwork, processing the fieldwork data and preparing draft curriculum resource materials. Conceptualising the project involved activities that were essential to set out goals procedures for the project. Planning the fieldwork involved identifying fieldwork sites, selecting and orienting field researchers and field supervisors, and preparing methods and modes of data collection and reporting. Considering accessibility, timeframe and the available budget, Vajrayogini and Chitlang Village Development Committees were selected as the fieldwork sites. The field researchers and field supervisors visited two Tamang and Gopali communities for a period of 4 weeks. Informal interview, observation, and field notes were the main data collection tools applied in this study. This data was supplemented by use of cameras to record still photographs and videos. On the recording of data focussed on capturing cultural practices that have a direct relationship with mathematical concepts in the lower secondary school mathematics curriculum of Nepal. The fieldwork data were classified and tabulated on the basis of mathematical concepts included in the lower secondary mathematics curriculum of Nepal. The first step in preparing draft curriculum resource materials was to develop a unique conceptual model linking pedagogical strategies with the nature of mathematics. This model was used to orient the curriculum writers’ group (comprising field supervisors and three field researchers) to developing curriculum materials that promote culturally contextualised mathematics education via progressive pedagogical approaches.
In the Piloting and Evaluation phase, a one month-long trial was carried out in July/August 2007 in Ugra Tara Lower Secondary School, Ghumar Chowk, Bajrayogini. The trial comprised four major activities: orientation of teachers and parents, classroom observations, familiarisation of materials and follow-up. Immediately after having conducted a general orientation for teachers and parents, a five day focused orientation and piloting phase (spread over 4 weeks) was organised for a group of 12 teachers in order to help them understand not only the mathematical concepts embedded in the materials but also how to enact student-centred pedagogical approaches. With a view to understanding the perceptions of the teachers, students and parents, a series of group discussions was organised throughout the process of trialling.

Numerous local practices were identified as being linked to mathematics curriculum at the lower secondary level. In particular, practices of farming, local business, household activities, children's games, cultural practices, artefacts and social events were found to be strongly linked to school mathematics concepts. An exciting and unexpected finding was that many traditional games played by children can be a highly significant activity for enhancing their learning of school mathematics, especially by adding a focus on learning by doing.

A unique conceptual model, the Mandala Model, was developed in order to facilitate the writing of the curriculum support materials on the basis of the outcomes of the fieldwork. Consequently, five sets of curriculum resource materials were prepared. The first four sets of resource materials are intended for teachers and students while the fifth set was prepared for enhancing parental awareness. The curriculum resource materials were trialled in a school with 12 teachers, 47 students and 7 parents who showed very positive attitudes toward the teaching and learning activities associated with the curriculum materials. Teachers who were present in the validation seminar were found to be positive toward the curriculum support materials.

The main objective of the project, to prepare culturally contextualised curriculum materials for teachers and students based on the Lower Secondary Mathematics Curriculum of Nepal and an awareness material for parents, has been accomplished successfully, thereby generating some important implications for instilling inclusiveness in mathematics education in Nepal.
Introduction

Rationale

The project was set up to develop culturally contextualised mathematics curriculum resource materials for the lower secondary schools of Nepal in order to foster a culturally pluralistic society. Specifically, the project focused on the socio-cultural practices of women and economically disadvantaged ethnic communities – Tamang and Gopali – of Hilly regions of Nepal.

A. Objectives

- To build a knowledge base of the ethno-mathematical knowledge, practices and languages of economically disadvantaged communities of Nepal.
- To develop culturally contextualised curriculum resource materials to supplement the existing lower secondary mathematics curriculum.
- To make local stakeholders aware of the cultural contextualisation of mathematics education.
- To enable lower secondary school teachers to develop a culture-sensitive pedagogy based on principles of cultural inclusiveness, gender equity and student-centred teaching and assessment.
- To improve student achievement and participation in mathematics at the lower secondary level.

B. Context of the Project

A protracted problem facing school education in Nepal is general underachievement and poor participation rates of pupils in mathematics (EDSC, 1997, 2003). The problem is especially bad for female students. A recent UNESCO-initiated study (Koirala & Acharya, 2005) found that Nepalese girls’ achievement in school mathematics is consistently below that of boys. A major contributing factor was found to be teachers’ gender stereotyping views of girls’ future social roles as home-makers rather than as prospective workers or professionals. Another factor contributing to the problem of underachievement and poor participation of both boys and girls is the narrowly conceived understanding of school mathematics as having the exclusive purpose of preparing an academic elite for entry into higher education in mathematics-related disciplines (Ernest, 1991; Luitel, 2003), thereby excluding the interests of the majority of pupils who, especially in Nepal, will leave school early and return to their local communities. This narrow academic view has resulted in (i) the design of curriculum materials and textbooks that present a formal, abstract and decontextualised view of mathematics and (ii) a didactic teaching approach to the delivery of content to passive-receptive pupils: a one size fits all approach.
This problem is best understood from a socio-cultural perspective that draws a direct connection between cognition and culture. Nepalese school pupils, particularly in rural cultural communities, are experiencing schooling as one-way border crossing (Giroux, 1992) which requires them to leave their home culture at the school gate and move into the alien culture of the school. Many struggle to come to terms with the foreign language of instruction (English) and with the irrelevance of the decontextualised content of textbook directed mathematics lessons (Luitel & Taylor, 2007). A typical student response is to resort to Fatima’s Rules (Aikenhead, 2000) - meaningless rote recall of rules and algorithms - thereby contributing significantly to the problem of underachievement in examinations. Worse still, the absence in the mathematics curriculum of reference to children’s home culture and the silencing in the classroom of their natal language is creating a clouded image in the minds of many that their post-school economic future lies outside their apparently undeveloped local communities, in distant towns and cities. Non-acknowledgement of reasoning styles of women and ethnic communities (Walkerdine, 1994) has severely affected pedagogic practices of teachers. The problem of one-way border crossing has been documented by education researchers in comparable Pacific Island nations (Aliawi, 2005; Waldrip & Taylor, 1999). From this perspective, we are seeing the failure of schooling, and school mathematics in particular, to contribute to local community development throughout Nepal and to the growth of an academic elite that is losing a vital nation building connection to its own cultural roots.

Thus, the challenge for mathematics education in Nepal is to take a more inclusive view of the purpose of school mathematics with the goal of providing a more relevant and socially responsible curriculum delivered via contextual resource materials that engage all students actively in meaningful and relevant learning experiences in accordance with the nation’s philosophy of Education For All (Ministry of Education and Sports, 2001). This challenge translates into one of creating a more culture-sensitive mathematics curriculum that builds a bridge between students’ home cultures and the academic culture of school mathematics. The critical feature of such a curriculum is that it promotes two-way border crossing (Giroux, 1992), inasmuch as it enables students to develop essential mathematical knowledge, skills and attitudes whilst, at the same time, experiencing a strong sense of the relevance of school mathematics to their local communities. A culture-sensitive mathematics curriculum contributes significantly to fostering students’ cultural self-esteem and cultural identities (Sfard & Prusak, 2005). It is important to understand that the inclusivity that lies at the heart of a culture-sensitive mathematics curriculum aims to provide multiple educational outcomes, empowering students with meaningful mathematical knowledge and skills for a range of possible social roles, including home-making, employment in local communities and academic success leading to higher education. Such an enacted curriculum needs to be built on a broader understanding of the nature of mathematics in which mathematics is understood as arising from familiar cultural activities.

The key to developing a culture-sensitive and child friendly mathematics curriculum for Nepal involves exploring and documenting the mathematical practices and underlying knowledge systems of local communities, especially in rural cultural settings where largely intact indigenous cultures are continuing to use traditional methods of counting,
ordering, patterning, categorising, measuring, building, weaving, farming, husbandry, etc. These diverse ethno-mathematical knowledge systems (D'Ambrosio, 1994) are embedded in people's daily cultural practices and have enabled them to successfully understand, explain and manage their natural environments in ecologically sensible and sensitive ways for eons. Although some research has been conducted into Nepalese ethno-scientific knowledge systems (UNESCO, 2005), this is the first project that has been established to develop curriculum support materials for teachers and students by tapping an immensely rich source of cultural knowledge situated in the everyday social practices of rural Nepal. In this project we focussed on the Tamang and Gopali communities in the Kathmandu Valley.

As a means of taking the first step towards the long-term goal of designing a fully culture-sensitive mathematics curriculum at the lower secondary level for Nepal this project was designed to achieve the short-term goal of developing a relatively small number of supplementary curriculum resource materials. We envisaged that these materials would link newly documented ethno-mathematical knowledge directly to selected mathematical concepts within the existing nation-wide mathematics curriculum. In the planning stage of the project we envisaged designing one-page vignettes of selected ethno-mathematical knowledge accompanied by photographic images illustrating the social context in which the knowledge is practised in local communities. Because of the intimate relationship between language, knowledge and culture we believed it to be essential that each vignette contains a narrative account written in the language of the local community from which it was obtained as well as translations into Nepalese and English.

The national significance of this relatively modest project lies in its contribution to addressing strong public concerns about the urgent need to document and conserve the cultural heritage of Nepal which comprises over 90 distinct language groups, many of which are facing cultural extinction (Rapacha, 2006; Toba, Toba & Rai, 2006). There is a strong parallel with international research efforts to document and conserve Nepal's unique natural heritage in the face of changing ecological dynamics (UNESCO, 2005).
Procedure

The main purpose of this section is to describe the procedures that were followed to carry out the activities of the project. The project adopted a two-phase procedural strategy in order to develop the culturally contextualised materials for teachers and students and support materials for parents.

A. Development Phase

The development phase comprised the activities of conceptualising the project, carrying out the fieldwork, processing the fieldwork data and preparing draft curriculum resource materials.

1. Conceptualizing the Project

Conceptualising the project involved: (a) reviewing national and international literature on ethnomathematics and recent national research reports, (b) analysing videos of potential ethnomathematical practices, (c) reviewing the school mathematics curriculum of Nepal, (d) sharing with local and international curriculum experts, and (e) gathering background information about specific cultural-ethnic groups in Nepal.

2. Planning and Conducting Fieldwork

Planning the fieldwork involved identifying fieldwork sites, selecting and orienting field researchers and field supervisors, and preparing methods and modes of data collection and reporting. Considering accessibility, timeframe and the available budget, Vajrayogini and Chitlang Village Development Committees were selected as the fieldwork sites. The field researchers were provided with orientations mainly on educational ethnography, survey, ethnomathematics, interviewing and observation, focus group discussion and the mathematics curriculum of lower secondary level. During orientation the field researchers and field supervisors constructed data collection tools and identified required logistics for the fieldwork.

The field researchers and field supervisors visited two Tamang and Gopali communities for a period of 4 weeks. First contact was made with local schools who organised selection of family houses in which the researchers stayed to during the fieldwork. Six field researchers (three in each community) stayed in the houses of farmers, local business people and people providing community services. Informal interview, observation, and field notes were the main data collection tools applied in this study. This data was supplemented by use of cameras to record still photographs and videos. The field researchers also prepared brief biographies of a selected group of students, parents, local stake-holders (parents of local school) and mathematics teachers in the local schools. On the recording of data focussed on capturing cultural practices that have a direct relationship with mathematical concepts in the lower secondary school mathematics curriculum of Nepal (ANNEX II).
3. Analysis of Fieldwork Data

Immediately after the fieldwork the international expert and lead researcher organised a series of meetings with the field supervisors and researchers. The fieldwork data were classified and tabulated on the basis of mathematical concepts included in the lower secondary mathematics curriculum of Nepal (Annex II). The purpose of teasing out key mathematical concepts was to facilitate the task of preparing draft curriculum resource materials which make use of local cultural practices.

4. Curriculum Materials Preparation

The first step in preparing draft curriculum resource materials was to develop a unique conceptual model linking pedagogical strategies with the nature of mathematics (see Figure 1). This model was used to orient the curriculum writers’ group (comprising field supervisors and three field researchers) to developing curriculum materials that (a) linked traditional school mathematics with local cultural mathematics and (b) extended traditional teacher-centred instruction to more student-centred methods of learning. Initially sample materials were developed to serve as an exemplar for the writers’ group. In the process the project team identified four major conceptual areas of the Nepali lower secondary mathematics curriculum that would be targeted by this project (see Annex II). Given the restraints of time and human resources available to this project the initial project goal of translating resource materials into local languages was deferred. As the writers’ group drafted curriculum resource materials formative evaluation was provided by the international consultant, project leader and UNESCO. A total of four sets of curriculum resource materials (see Annex) for teachers and students and one set of parental awareness materials were prepared in two languages, namely, Nepali and English.

B. Piloting and Evaluation Phase

The purpose of the piloting and evaluating phase was to examine the perceptions of those for whom the curriculum resource materials had been targeted. A one month-long trial was carried out in July/August 2007 in Ugra Tara Lower Secondary School, Ghumar Chowk, Bajrayogini. The trial comprised four major activities: orientation of teachers and parents, classroom observations, familiarisation of materials and follow-up.

1. Orientation & Pilotting

Facilitated by the field supervisors and two field researchers and attended by teachers and parents, a one-day general orientation was conducted. The purpose and use of the culturally contextualised curriculum resource materials was outlined and evaluative feedback was sought from the participants.

Subsequently, a five day focused orientation and piloting phase (spread over 4 weeks) was organised for a group of 12 teachers in order to help them understand not only the mathematical concepts embedded in the materials but also how to enact student-centred
pedagogical approaches. On completion of each focussed orientation day, the trial teachers implemented the curriculum resource materials (teacher and student support materials) in their classes. The researchers conducted observations in the teachers’ classes in order to understand how classroom dynamics affected the implementation of the materials. With a view to understanding the perceptions of the teachers, students and parents, a series of group discussions was organised throughout the process of trialling.

In light of the evaluation results of the orientation and piloting phase modifications were made to the curriculum resource materials

2. Validation Seminar

Finally, a validation seminar was conducted toward the end of the project to obtain expert summative evaluation from a range of professional educators. Participants included professors of mathematics, curriculum officials, teacher educators, teachers (see Annex XI). Feedback obtained from individual readings and group discussions were used to finalise the curriculum resource materials.
Key Outcomes of the Project

The section outlines the key outcomes of the project: outcomes of the fieldwork, outcomes of the curriculum development process, and outcomes of piloting and evaluation.

A. Outcomes of the Fieldwork

1. Numerous local practices were identified as being linked to formal mathematics at the lower secondary level. In particular, practices of farming, local business, household activities, children's games, cultural practices, artefacts and social events were found to be strongly linked to school mathematics concepts (Annex I and Annex II). These contexts were incorporated into the curriculum resource materials in order to enhance children's learning of school mathematics, especially girls whose lived experiences and family social roles will be legitimated in formal education by such contextualisation (Annex IV and V).

2. Analysis of the lower secondary school mathematics curriculum of Nepal revealed formal geometric, arithmetic, algebraic and set theory concepts that could be linked directly to local practices and day-to-day life activities documented in the fieldwork data (Annex II).

3. The field study indicated how parents and elders can help their children's learning of mathematics at home by engaging them consciously in local activities linked directly to school mathematics, such as wages, expenses and cost calculation and estimations. Given the fact that children cannot escape from household work, a possibility observed in the fieldwork was that children can enrich their mathematical understanding by linking their classroom learning with their daily household activities (Annex III).

4. An exciting and unexpected finding was that many traditional games played by children can be a highly significant activity for enhancing their learning of school mathematics, especially by adding a focus on learning by doing. The games children play were found to be richly contextual for learning mathematics with physical movement, logic and reasoning (Annex III).

5. The fieldwork data provided many examples of how to build a much more extensive knowledge base of the many ethno-mathematics communities of Nepal (ANNEX I, II, and III).

B. Outcomes of the Curriculum Development Process

1. A unique conceptual model, the Mandala Model (see the figure) (Taylor, Luitel, Belbase & Pokhrel, 2007), was developed in order to facilitate the
writing of the curriculum support materials on the basis of the outcomes of the fieldwork. The model resembles a Mandala and has four quadrants determined by pedagogical and mathematical axes. The model promotes crossing the border between conventional mathematics teaching and learning from an instructionist pedagogy (IP) and moving towards a social constructionist pedagogy (CP) of contextualized mathematics (CM) (local, artefactual, communal). The model provided a conceptual framework for writing the curricular resource materials as well as their classroom application in shifting the teaching and learning practices of mathematics from traditional school mathematics (TSM) to contextualized school mathematics (CSM), in the short term, and finally to contextualized progressive school mathematics (CSMP) in the longer term as shown by the curved arrow in the following figure.

Figure 1: The Mandala Model

2. Five sets of curriculum resource materials were prepared. The first four sets of resource materials are intended for teachers and students (ANNEX IV) while the fifth set was prepared for enhancing parental awareness (ANNEX V). The first set of curricular materials - ‘Sets Around Us’ - focuses on the exploration of ideas of mathematical sets from daily life activities in the kitchen, garden, shop and farmland. The second set of materials - ‘Arithmetic in our Daily Life’ - visualizes the day-to-day application of counting and problem solving. The third set of materials - ‘Grand Tour of Geometry’ - deals with the exploration of geometrical...
concepts from various artefacts such as doko (wicker basket), ghum (locally prepared Rain Shield/Cover), house stricture and temple. The fourth set of materials - ‘Measurement Around Us’ - demonstrates connections between informal ways of weight measurement in the home and community using the hand, mana (one mana is 10 handfuls, approx 400 grams), pathi (approx 3.2 kg, one pathi is equivalent to 8 manas; can also refer to the brass or copper vessel which contains a pathi of grain), dharni (weight of approx 2.4 kg), and muri (one muri is equivalent to 20 pathis) and standard units of weight measurement. The fifth set of materials - ‘Mathematics in Our Daily Life’(ANNEX V) - intends to encourage parents to explore mathematical ideas from their daily life activities and help their children construct mathematical understanding from household activities.

C. Outcomes of Piloting and Evaluation

1. Twelve teachers in one school were provided with basic orientation on how to use the culturally contextualised resource materials and 47 students were involved in classroom trialling. Seven parents expressed their renewed positive attitude towards the mathematics learning of their children (ANNEX VI and VII).

2. Piloting of curricular materials revealed that the teachers, students, and parents had very positive attitudes towards the teaching and learning activities associated with the curriculum materials, thereby creating awareness about culturally contextualised mathematics education among teachers, students and parents at the community where the piloting was conducted (ANNEX VI, VII, VIII and IX). The teachers showed enthusiasm for using these materials in their classrooms and their students found the learning activities to be interesting. Specifically, teachers were found to be teaching mathematics with more contextualized activities. However, it could not be concluded that the teachers who participated in piloting used fully participatory and inclusive teaching strategies as envisaged by the quadrant of CSMP in the Mandala Model (ANNEX, X).

3. 31 participants of the validation seminar engaged in the curriculum support materials by reading the materials and providing constructive feedback for further development such as incorporating more problem solving cases and orienting materials for empowerment of teachers and students. Nevertheless, teachers who participated in the validation seminar were found to be more positive toward the curriculum support materials than the university professors (ANNEX, XI).
Implications and Emerging Issues

This section considers the general implications of this project for transforming the mathematics curriculum of Nepal

A. In capturing the everyday mathematical practices of two ethnic communities in rural Nepal this project has made a timely and significant contribution to documenting a hitherto unrecognised aspect of Nepal's cultural heritage. By incorporating ethno-mathematical knowledge system (i.e., impure: local, artefactual, communal) within the lower secondary school curriculum, the project has demonstrated the feasibility of a culture-sensitive approach to curriculum design for providing Nepali children with an educational bridge for making their way across into a developing modern world economy. Importantly the bridge enables them to return back again at will, thereby minimising the risk of becoming stranded half-way across in a cultural no-man's land.

B. Given the educational zeitgeist of ‘education for all’, this project is a unique example of developing meaningful, applicable and relevant curriculum materials that help inculcate a critical scientific literacy (matheracy) which is essential for a country striving to ‘modernise’ education, to produce active and critical citizens and to instil democratic life values.

C. Whereas the mathematics curriculum of Nepal has been guided solely by a view of the nature of mathematics as a culture-free and pure body of knowledge (pure: symbolic, algorithmic, abstract) (Luitel & Taylor, 2007b) that is suited largely for academically bright students, the curriculum resource materials developed in this project constitute a first step to countering such a hegemonic view by offering alternative knowledge systems residing in the cultural practices of people’s lives.

D. Although the piloting indicated that teachers showed a positive attitude toward the curriculum support materials and that they used contextualised activities in their teaching, there is a pressing need for the professional development of teachers so as to inculcate more participatory and inclusive pedagogical approaches.

E. The Mandala model designed to guide the development of curriculum materials in this project may be adopted by the Curriculum Development Centre (CDC) so as to make the national mathematics curriculum more inclusive of and meaningful to all Nepali students (Luitel & Taylor, 2008; Taylor & Luitel, 2007). This does not mean that the Mandala model needs to be replicated exactly, rather a creative adaptation of the model may be helpful for incorporating Nepali people’s daily practices in the school mathematics curriculum.

F. A pedagogical implication of this project is the feasibility of cultivating meaningful teaching and learning approaches in relation to the varied cultural contexts of Nepal. As this project has demonstrated the possibility of incorporating cultural practices into the existing curriculum, this approach may be
disseminated widely among schoolteachers so that they can incorporate the notion of cultural contextualisation in their teaching.

G. A number of publications based on this project have already attracted international attention among the mathematics education and science education communities (see List of References). This unique project may soon generate international collaboration among educators from Asia, Africa and other parts of the world to explore the many culturally diverse ways in which mathematics education and science education can be made more meaningful for and inclusive of the lives of students worldwide.

H. Comments made by some participants (ANNEX XI) of the validation seminar that in the context of globalisation there should a focus on ‘decontextualised mathematics’ (pure: exclusively formal, symbolic, abstract) (Luitel & Taylor, 2007, 2007 a, 2007b) rather than on contextualised mathematics (local, communal, artefactual) indicates a need for awareness of culturally contextualised mathematics among Nepali teacher educators and mathematicians who could play a vital role in making mathematics education an inclusive and transformative enterprise by embracing a wider view of globalisation as a platform for dialogue between different cultures. Such a notion of globalisation can develop an empowering view of mathematics as an im/pure (combination and interaction of both pure and impure mathematics) knowledge system.
Conclusions

Setting out to develop culturally contextualised curriculum support materials for teachers and students and a material for parental awareness, the project produced five sets of support materials incorporating the cultural practices of Tamang and Gopali communities. By following a two-phase procedural strategy the project demonstrated a unique possibility of integrating Nepali local cultural practices in school mathematics curriculum.

In relation to the first objective the fieldwork records and curriculum support materials provide a valuable knowledge base for contextualization of mathematics teaching and learning in Nepal. The second objective, to develop contextualized curricular materials, was achieved with the development of five sets of materials. The third objective, to make local stakeholders aware of the cultural contextualisation of mathematics education, was achieved in relation to the teachers, students and parents at the community where piloting was conducted. The fourth objective, to improve teaching and learning of mathematics by developing culturally sensitive pedagogy-based learning materials, was partially achieved during the piloting phase in which teachers were found to be teaching mathematics with more contextualized activities. The fifth objective, to improve student achievement and participation in mathematics, is a long-term objective which requires continuous follow-up research and support mechanisms embedded in the system. Nevertheless, during the piloting and evaluation teachers, students and some teacher educators suggested that these support materials can increase student participation because they link mathematics with their day-to-day practices.

The project also gave rise to a number of implications for and emerging issues of inclusive and meaningful mathematics education in Nepal. An important task lies ahead is developing a curriculum framework that provides a room for creativity and flexibility so as to incorporate local cultural practices and knowledge systems. Similarly, teachers’ professional development is one of the critical means for which to put country’s effort for inculcating the goal of inclusive mathematics education that considers the multicultural landscape of Nepal as a prime source for contextualised mathematics teaching and learning.
References


## ANNEX I: Ethno-Mathematics in Women practices

<table>
<thead>
<tr>
<th>Practice</th>
<th>Context (People, place and time)</th>
<th>Process</th>
</tr>
</thead>
</table>
| 1. Math in *khole* (gruel making process) | Asmita's mother/52, kitchen morning | -1 big *dekchi* filled with 1 *gagri* (3 *pathi*) is put on fire.  
-One handful; (*pasar*) salt is added.  
-1 *pathi* dhuto /pitho is also added.  
-It is put on firewood for about half an hour.  
-Taken out from fire and 2 *gagri* of water is added. |
| 2. Math in *Chyang* making Process | Especially in morning/mother of the house/1st floor of the cottage | -Keep 10 *manaj* of rice in a *Phosi*.  
-Wash at once keeping water and allow so that the water flows out.  
-Add 8 *manaj* of water/or deep the index finger into the pot and measure the level of water upto 2nd and not from the tip of the finger.  
-Keep the *Phosi* in wooden fire. Boil it for about 1/2 hour.  
-After it is cooked, it is kept into another pot (*hata*) by panu. - Then it is spread in the mat for 15 minutes.  
-Then single piece of yeast (*Marcha*) is crunched into small pieces and properly added in the rice.  
-Then the rice is mixed with yeast. It is kept in a sack and the sack is kept in bamboo container (*dalo*).  
-Small hole is made in the middle of the rice and one or 2 *philingo* of fire is kept.  
-Then the sack of the rice is closed tightly and basket/bamboo container is kept in one corner.  
-After 24 hours the mixture is kept in mud made vessel and its mouth is closed.  
-After 4 or 5 days, the closed mouth is opened and taken out according to necessitated appropriate time.  
-Then water is added in the mixture according to its necessity.  
-Water is added/stirred in a jug and *Chyang* is ready to drink. |
### 3. Math in Chheki Khel

When children gather together, Children of age 5-15/in front of school/courtyard (Aangan)
- Threads/sticks/drawing line/joining from one to another point.
- Children play in-groups of (2-6,8) persons.
- Children draw parallel line in the ground intersecting into one another.

### 4. Math in Squash Kheti

In front of the house, kitchen garden/morning or evening/by family members/selling in Sankhu town
- In one big Doko, there will be 25-30 Dharni of squash.
- In medium sized doko 20-22 dharni of squash.
- In small sized doko 12-15 dharnis of squash.
- Each Dharni's (2 and half Kilo) the selling price is Rs 6-8 in Sankhu.
- The cost of the squash per dharni varies week to week/months to months.
- In starting season, (Jestha) it costs high ranging 40 to 45 rupees per dharni.
- Ashadh month Rs 40 per Dharni.
- Shravan month Rs. 35 per Dharni.
- Bhadra month Rs. Rs 8 per dharni.
- Aswin month Rs. Rs 8 per dharni.
- Kartik month Rs 10 per dharni and so on.
- In the end of squash season Rs. cost varies from 5-10.

### 5. Math in making bunch of Maize (Makaiko Jhutto)

Any time in season
- 2 to 10 ghogas of maize is taken.
- It is divided equally into two parts.
- Some bark of each leaf is opened and tied making a not.
- It then is kept in the rope so that it will be safe from pests, rats, cold.

### 6. Math in selling Milk

Morning/evening/
- Per mana of milk selling price is 15 rupees
- Price varies according to the fat contained in the milk.
- If the milk contains fat in 2 units the selling price of milk per liter is Rs.7.
  - If the milk contains fat in 3 units the selling price of milk
<table>
<thead>
<tr>
<th>Math in</th>
<th>Asmita's Mother/Asmita/evening.morning / Bari and field</th>
</tr>
</thead>
</table>
| 7. Measuring the food grains from Bari and field | - If the milk contains fat in 4.8 units the selling price of milk per liter is Rs. 19.  
- In one ghoga (middle sized) maize there will be around 500 grains, which will be nearly half mana. 2 ghoga becomes 1 mana, 8 mana is equal to 1 pathi, 4 pathi is equal to one tin, 5 tins are equal to 1 muri. |

<table>
<thead>
<tr>
<th>Math in</th>
<th>Chhungi Khel</th>
</tr>
</thead>
</table>
| 8. | - By kicking by the right foot and counting it.  
- Counting may be single or double according to the kicking quantity.  
- Some target number is fixed before playing like 50, 100 in which the game will be over.  
- 1, 2, 3 or 4 persons can play this game as well. |

<table>
<thead>
<tr>
<th>Math in</th>
<th>Gobar Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.</td>
<td>- Combination/mixture of 1 bucket of cow dung (nearly 5 Kilo) + 7 liter of water in the morning; and the same amount of combination of cow dung and water in the evening is necessary to generate sufficient gas to prepare food for five persons'.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Math in</th>
<th>Fruits, diagram, wet wheat flour etc</th>
</tr>
</thead>
</table>
| 10. | - Fruits can be divided into different parts by cutting it.  
- From adding or removing the parts fractions can be taught.  
- In the same way the wet wheat flour also can be used to give the concept of the parts or whole. |

<table>
<thead>
<tr>
<th>Math in</th>
<th>Food grains from field and Bari</th>
</tr>
</thead>
</table>
| 11. | - Total grains paddy (5 muri)+maize (10 muri)+wheat (5 muri)+millet (10 muri)  
- Among total food grain one third is used in eating and 2 third is used in liquor making  
- From one third, nearly 75% is used for preparing khole(food for animals) and 25% is used for men in the family. |

<table>
<thead>
<tr>
<th>Math in</th>
<th>Tape, scale, meter, hand, rope, stick, bita, paila</th>
</tr>
</thead>
</table>
| 12. | - To measure bench, room, tape, scale, meter, hand, rope, sticks, bita, paila.  
- One hat is equal to 18 inch.  
- 1 bita is equal to 9 inches.  
- 1 feet are equal to 12 inches. |
<table>
<thead>
<tr>
<th>13. Math in Total households in the village/total numbers of persons in the village</th>
<th>Teacher with the help of children</th>
</tr>
</thead>
<tbody>
<tr>
<td>-How many males/females/children are there in each family and as a whole in the village.</td>
<td></td>
</tr>
<tr>
<td>-Visiting each household and asking the number of the family can collect data.</td>
<td></td>
</tr>
<tr>
<td>-In each day how many dokas of iskoos are sold from one house?</td>
<td></td>
</tr>
<tr>
<td>-How many students get what rank during exams?</td>
<td></td>
</tr>
<tr>
<td>-Classification of students according the surname?</td>
<td></td>
</tr>
<tr>
<td>-Classification of students according to sex.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>14. Math in Dhak/Taraju</th>
<th>Maili Thing</th>
</tr>
</thead>
<tbody>
<tr>
<td>-By adding stones/or taking out the stones problems of equation can be solved.</td>
<td></td>
</tr>
<tr>
<td>-By breaking the sticks/and adding it.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15. Math in childrens school education expenses</th>
<th>Ranju/Asmita/ class room/day time</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Admission fee of son to admit in school 900.</td>
<td></td>
</tr>
<tr>
<td>-Book and copy-1200.</td>
<td></td>
</tr>
<tr>
<td>-Per month fee-480.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>16. Math in wooden materials</th>
<th>Ranju/Asmita/ class room/day time</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>17. Math in household utensils</th>
<th>Asmita</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ring/plate/nanglo</td>
<td></td>
</tr>
<tr>
<td>Perimeters and circles can be taught from kitchen utensils as spoons, forks, panyu dadu.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>18. Math in roof Strauss</th>
<th>Ranju Madam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small sticks/pens/chalk/flag/roof supporter.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>19. Math in the accessories in classroom</th>
<th>Ranju Madam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackboard/frame of the window/door.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>20. Maths in Doko</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>-Eyes of the doko are shaped in hexagon.</td>
<td></td>
</tr>
<tr>
<td>-The perimeter can also be measured from the wide mouth of the doko</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>21. Maths in leaf/sticks fruits</th>
<th>Asmita/other children</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Different groups / sets can be made from the various sizes/varieties of leaves, sticks and fruits</td>
<td></td>
</tr>
</tbody>
</table>
ANNEX II: **Specific Findings from Tamang and Gopali Communities**

Six key sociocultural contexts, daily activities and informal mathematics have been identified as having strong conceptual links with Year 6 & 7 school mathematics curricula.

<table>
<thead>
<tr>
<th>Context</th>
<th>Activities</th>
<th>Mathematics</th>
<th>Link to School Maths</th>
</tr>
</thead>
</table>
| 1. Farming and Mathematics       | - Potato growing            | - Arithmetic in estimation of seeds, cost of growing crops and benefits from it. | - Data collection and presentation  
- Bar-diagrams  
- Line and line segments  
- Intersecting and parallel lines  
- Angles and construction of angles using protractors  
- Perimeter and area  
- Introduction to sets and its types  
- Operation of sets |
|                                  | - Millet growing            |                                                                             |                                                                                     |
|                                  | - Maize growing             |                                                                             |                                                                                     |
|                                  | - Scoosh growing            |                                                                             |                                                                                     |
|                                  | - Buffalo keeping           |                                                                             |                                                                                     |
|                                  | - Goat keeping              |                                                                             |                                                                                     |
|                                  | - Arithmetic in estimation of seeds, cost of growing crops and benefits from it. |                                                                             |                                                                                     |
|                                  | - Geometry in terrace farming, planting crops in queue, making bamboo support in the form of roof and designing and using digging and ploughing equipments. |                                                                             |                                                                                     |
|                                  | - Sets in grouping the good and bad crops, storage of crops, keeping animals in a single shed. |                                                                             |                                                                                     |
| 2. Local Business and Mathematics| - Selling farm products in local market | - Arithmetic in selling milk to local collection centre  
- Arithmetic in selling scoosh to local market  
- Arithmetic in selling goats to market  
- Arithmetic in purchase of rice and other food items  
- Arithmetic in purchase of clothes  
- Arithmetic in purchase of other day-to-day goods  
- Arithmetic in purchase of stationeries for students  
- Lending money to others and earn interest from it. | - Fraction and decimals  
- Simple word problems from ratio and proportion  
- Profit and loss  
- Profit and loss percentage  
- Unitary methods (direct and indirect variation)  
- Simple interest  
- Problems on simple interest |
|                                  | - Purchase of day-to-day goods |                                                                             |                                                                                     |
|                                  | - Exchange of goods with goods |                                                                             |                                                                                     |
|                                  | - Burrowing money            |                                                                             |                                                                                     |
| 3. House Hold Works and Mathematics| - Cooking                  | - Set in cooking  
- Function in cooking  
- Algebra of cooking  
- Measurement in cooking  
- Arithmetic in clothing | - Introduction to set and operations of sets.  
- Algebraic expression, addition, |
|                                  | - Clothing                  |                                                                             |                                                                                     |
|                                  | - Cleaning                  |                                                                             |                                                                                     |
### 2. Measurement in clothing
- Arithmetic in cleaning
- Function in cleaning

### 2. Subtraction of algebraic expression
- Simple word problems of ratio and proportion.

### 4. Children's games and plays and Mathematics
- **Games**
- **Plays**
- **Geometry in games**
- **Algebra in games**
- **Arithmetic in games**
- **Reasoning and logic in games and plays**
- **Algebraic thinking in games and plays**
- **Geometric thinking in games and plays.**
- **Lines and line segments**
- **Parallel and perpendicular lines**
- **Quadrilaterals**
- **Algebraic expression**
- **Similarity and congruency**

### 5. Others and Mathematics
- **Cultural rituals**
- **Art and crafts**
- **Social Activities**
- **Family**
- **Birth and Death**
- **Local club**
- **Guthi system**
- **Family practices**
- **Set**
- **Algebraic expression**
- **Equations and inequalities**
- **Number system**
ANNEX III: Discussion of the Specific Findings of the Field Report

The matrix above (ANNEX I and II) shows that there are many opportunities for the curriculum practices of school mathematics to be supplemented by resources drawn from the local context in order to enhance the emotional and intellectual engagement of Years 6 & 7 students. Local context can help students understand mathematical phenomena from the perspective of their own lived experiences. The above sociocultural contexts of farming, local business, games and play and cultural rituals can be connected to school mathematics in various content areas such as geometry, algebra and arithmetic in order to make mathematics much more interesting and worthwhile for all students, especially girls.

Adding meaningful contexts of local activities that make sensible connections with classroom mathematics can bring a change in the attitude of teachers and students in the teaching and learning of mathematics. The meaningfulness of contextualizing mathematics in real life or in applied contexts is of growing concern worldwide, and this study has identified specific possibilities of such contextual links between day-to-day practice and school mathematics.

**Farming and Mathematics**

Farming in Tamang and Gopali community can entail a relationship of fertilizer used and production of crops. This is a significant mathematics that contributes in the understanding of nature and application of mathematics in rural setting. The potato growing can be linked with arithmetical operations such as addition, subtraction, multiplication, division, time and work, ratio and proportion and also applied geometry of designing the plot, shaping the groove and mapping the queue of potato plants.

Terrace farming is a popular method of managing land in the hilly region in Nepal. It was found that Tamang and Gopali people used this method in their field as well. This carries a lot of geometric significance and that can help in classroom discussion in teaching and learning of geometry.

The farming of millet, scoosh, and other vegetables that has economic value in the community has an important sociocultural foundation rooted in mathematics that can widen the contextual learning of school mathematics. Scoosh farming had been found to be one of the dominant farming practice Tamang communities that involved the people in designing the bamboo support to scoosh plant, measuring the lengths of bamboo rods and putting them in the form of a net, putting fertilizer around the roots, picking the scoosh vegetable, weighing the scoosh, selling them in local market and earning some money as a part of their livelihood. All these practices were found to be interconnected with different areas of mathematics.

Buffalo keeping was another major profession in some households in the Tamang community. They were found to be very careful in the purchase of buffalo looking its body structure and they guessed the amount of milk it could give in a day. The family
members were found to be busy in taking care of buffaloes from morning to evening giving them green grass, grain food cooked in a big pot, husks and remains of rice mills. They were found to be mathematically clever in the case of profit they made and the expenses they had in the taking care of the buffaloes. There was a local milk collection centre and all the farmers who brought milk were careful about the relationship of price of the milk with the fat content in it. They were found to be aware of direct relationship of fat content in the milk and the rate that was fixed accordingly. There was good recording system of fat content level, volume of milk and price rate of each day. This could bring a lot of mathematical discussion in the classroom teaching and learning that seemed to be helpful to both the teachers and students.

A half circular wooden disc connected with a handle at the middle forms a tool to push and pull rice grains while it is scattered on a mat to dry. It is locally called *khuin*. It can be referred to as an cultural artefact that is widely used in agriculture. It can be used in the classroom teaching of area of half circle, application of concept of circle to make it and the amount of rice that is proportional to its surface area.

Fig. 1 *Halo* (Wooden Plough)

![Halo (Wooden Plough)]

The wooden plough in the above figure was pictured in Gopali community. This also carries a lot of geometrical meanings that can provide rich context in the classroom teaching and learning of mathematics.

So, it we can say that farming can be a referent and a construct in the understanding of school mathematics from local setting that provides immediate contexts of students' lives.

*Local Business and Mathematics*

Both the Tamang and Gopali community had their local businesses. Some of the people in those communities were fully dependent in the business of vegetables, animal products and day-to-day goods. Some households were found to engage in both business and farming. The dominant business in both the communities were buy and sale of vegetables and buffalo milk. Some people were found to collect vegetables grown in those communities and take them to nearby city for sale. They also brought goods from market...
to sell in the village. Their business involved a wide range of arithmetical operations and some statistical analysis. They were found to be aware of local price and market price of the items they bought and sold in the market or vice versa.

One local businessman in Gopali community had a local shop in Nhul Gaun and he was involved in the purchase of goods from market and selling them in the village. His business could be a rich context of classroom mathematics for the teachers and students. Local students were found to come there and purchase the stationeries they required. Parents and others were also found to visit the shop and buy goods for their day-to-day life. During their purchase I found various mathematical operations such as purchase price, selling price, discount, cash purchase, credit purchase, change of money, addition of total price, subtraction of total price from money paid and find the return, multiplication as repeated addition, division, relationship of amount of purchase and discount, and many more other contexts.

I had talked to a man in Tamang Community who was involved in business of alcohol production from grains and selling to local people. He explained me the process of fermenting millet, and distilling the alcohol by a traditional method at his home. At the moment I was talking to him, there was big vessel being heated by fire and he was changing the water at its cover. I asked him the amount of millet used, and amount of alcohol he could produce, cost of all the processes and income from the sale of alcohol. It was a pretty nice local context of mathematical application in business that could bring a lot of matters for discussion in the classroom teaching and learning. It could capture rich arithmetical operations of purchase, sale, profit, loss, ratio and proportion, direct variation, time and work and estimation.

This study found that there are many more local business practices that can provide a wider range of context for classroom teaching and learning mathematics valuing the sociocultural phenomena and analysing them from mathematical point of view.

*Household Works and Mathematics*

Parents and children were found to be involved different household activities during the field visit. They were engaged in taking care of animals, working in the vegetable field, preparing food, washing dishes, weaving baskets and so on. All these activities had some mathematical ideas and application too. These activities could be a great deal of context for classroom teaching and learning of mathematics. We had found some men chopping firewood and some women weaving mat. We also found some students helping their parents in the harvest of rice too. Every activity in their day-to-day life had a mathematical sense just we need to view through the lens of mathematical view and through the link of sociocultural aspect of mathematics. Then I think classroom teaching of mathematics could be linked with those activities in a more meaningful way so that learning could be fun, learning could be worthy and contextual.
The woman in the above figure was pictured in Tamang Community. She is skilled in weaving mats from maize leaves and rice plants. Her art of making mats has a great mathematical significance. She designs the mat of different shape even without knowing the formal name of the shapes in geometrical terms. This depicts that children can bring a lot of local issues of application of mathematics from their household practices to classroom that can help girls to understand the value of learning mathematics and also it makes learning mathematics a fun.

While taking care of animal it was important to feed them nourishing food that contained green grass, thatch of rice and wheat, maize powder and remains of vegetables. It can be a context of teaching set, fractions, ratio and proportion, percent, measurement and so on. There is direct relationship of nutrition in the food and milk they give.

Parents work in the vegetable garden and children help them. When they planted potato in a field they had to perform different activities. We found them to dig the field with their spade. The spade had definite geometric shape. The slope of blade could be changed a little to increase or decrease the efficiency in terms of depth and width. There was applied geometry while designing the groove to plan potato on the top of it. There were many parallel grooves and potatoes had been planted at a distance of one foot. The inter groove distance was about one and half feet.

Mother was preparing food and daughter was helping her in preparing vegetable. Mother measured the amount of rice with a pot called mana and then she put water in it measuring the depth with here four fingers. She then prepared vegetable putting some oil, spice, salt, yellow powder and coriander leaves. The ideas she thought simple and took simple way when we asked how she estimated the salt. But there was a great application of number sense, sense of volume and sense of time while cooking food. Mother was supported by her daughter and they really did it as if it was there routine to do. A real sense of mathematics and a real context of learning mathematics it was.
In this way there were many evidences of mathematics and its application in the day-to-day household works of men and women together with children. It shows that the people of either community had rich context of mathematical practices at home, field and other activities that could be a great point to start teaching and learning of mathematics in the school classrooms.

*Children's Games and Plays and Mathematics*

When we reached to Ugra Tara School at Ghumarchowk, Bajrayogini some children were playing Chheki in the school yard. They had made a geometrical sketch on the ground to mark the field to play. Some students were found to run from one end to other and some other were found to chase them. They were laughing at each other and seemed very happy. We watched their game for a while. I could see some rectangular sketches on the floor as a mark to separate the field of two sides. The rule seemed a bit complex at the beginning but the children were playing efficiently. It was difficult for us to understand the rule and the mark on the ground. After watching for about half an hour, we could understand the rule and the mark on the ground too.

The Chheki was really a nice and interesting game to children. It had application of geometry, counting and function. Also it was helpful to develop social attitude in the children. It was also helpful to develop quick decision making, logic and reasoning which are the foundations of mathematics learning.

Once in the field visit to Chitlang I saw some children playing at the side of the local road. A girl of age ten or eleven was throwing a flat stone piece to the other side of a rectangular net sketched on the ground. There were some rooms in the sketch that depicted different value. The girl jumped putting legs to different rooms and reached to the stone. Then she just stood with a leg. She hit the stone with a toe towards one of the room. According to the type of room that she could send the stone, she counted her score.

This game was name as *ladain* at that place. It was an exemplary game that had rich mathematical application. There was application geometry while making mark on the ground. There was counting and addition of scores. There was also function or relation in terms of score and players. The abstraction of game with logic and reasoning was also a major component that could be connected to children's learning of mathematics.

The figure below shows the net that children used to play *ladain* (fight) that has interesting geometrical pattern. It can help a lot in the teaching and learning of mathematics in the classroom. The small circles represent pebbles or grains.
Next morning I saw a boy and a girl playing a contest of winning pebbles and grains in a stone slab. They had marked a net on the slab with a clay chalk and played a game contesting each other putting the pebbles and grains at the cross section of lines. It seemed that they need high ability to analyze what the next few steps would be and what the opponent would move. They played for about fifteen minutes to finish one round of the game.

Sarita Gopali (age 11 years, grade seven student) is often found to play dog and bone with her colleagues. She says that there should be two teams A and B to play the game. Both teams should have equal number of students. They should stand in a set of parallel lines facing each other at a distance of 6 to 8 meters apart. A small circle is made at the middle of the two teams on the ground with a chalk, lime or scratching the earth. A red handkerchief is kept in the middle of the circle. A referee is appoint to start the game who does not belong to either of the teams. The referee counts the members of each group saying one, two, three, four ....and each player should have to remember their number. When the referee whiles and calls a number then one the players from both team with that number runs to catch the handkerchief. Score is given to a team whose player takes the handkerchief to their line first. At a certain time interval (20 min or 30 min) which team scores higher becomes the winner of the game.

There was geometry, counting, function, relation, ration and proportion, measurement of time, and also logic and reasoning. So, these games can be a great source of contextualizing mathematics teaching and learning in schools.

Festivals, Cultural Rituals, Artefacts and Mathematics

Mahadev Jaja is a local festival of Gopali people in Chitlang. This festival is celebrated after completing plantation of rice during rainy season. In this festival people go to Mahadev Temple and feed maize and salt to their bullocks. They feed more to the bullocks involved in ploughing and less to the rest of the bullocks. People bring duck
eggs from each household and offer them to Ganesh. They cook those eggs and again offer to Ganesh a little from each piece. They release their bullocks from the plough and send them in the field. The bullocks start fighting to each other. People enjoy bullock fighting and celebrate the festival with great fun. They bring the eggs back to home and have a feast with other food items at home.

Our short visit though three times was not adequate to capture different cultural rituals. Rituals are not performed all the time and some of them are rare too to see at other time except on special occasion. But we were able to see some rituals of performing worship to god during Dashain festival. We could collect some pictures of artefacts that depict the application of mathematics in social practices of people of both communities.

Tamang community celebrates Lhosar as their biggest festival though they also celebrate Dashain and Tihar too. The culture of Tamang during celebration of these festivals has rich contexts of applied geometry, arithmetic and set theory. The artefacts that they use during paying homage to god, offering worship to their ancestors and for other purposes were full of art and sacredness behind them as if they were .....

Ghum is a kind of rain-cover made of bamboo and leaves. The net shows a wider scope of interconnection of geometry with application in day-to-day life. There is different geometrical shape in it that provides a rich context to initiate discussion of parallel lines, triangles, quadrilaterals, angles and many more as required in the classroom. Ghum is a referent of applied geometry that shows how carefully local people in these communities apply geometry in such artefacts even without knowing formal geometry. The figure below shows the geometrical patterns in the ghum. Also it has calculations such cost of making a ghum, profit that can be made by selling it and time that it takes to make it.

Fig 4. Ghum (Rain Cover)

Doko was a very common artefact that we could see in both the communities. It showed a great application of geometry in the art of making doko with bamboo pieces. A single
doko carries several meaning with geometry, arithmetic, measurement, logic and reasoning. It is a combination of art and mathematics in real sense that can be living context in the classroom teaching of lines, curves, polygons, time and work, ratio and proportion, set and many more.

Mat was next interesting artefact that we found during our study in both of these communities. People made these mats out of maize leaves or rice plants. Some mats were circular disc and some were rectangular. These mats carried a living geometry with arithmetic and other areas of mathematics.

The figure below is a doko and it shows the practices of applying geometry and arithmetic in the making of artefacts. It is can provide a rich context for the children to learn parallel and intersecting lines, circle, polygons and many more.

Fig 5  *Doko (A Wicker Basket)*

Tessellation of roof with rock slates seemed to be a most fascinating application of mensuration and design applying some geometrical sense and it also showed a culture of mountain people to put slates in the roofs of their houses. The arrangement of slates in a pattern that makes the roof durable, safe and also adds some aesthetic value of using it at the top of house. It covers designing roof with application of geometry, mensuration, and arithmetical calculation and sets as well. So these roofs in the houses that carry a lot of mathematical meaning can be a real evidence of context for classroom teaching and learning of mathematics.

The figure below shows the tessellation of roof using rock slates. It shows a pattern that has beautiful geometrical shape. It has some aesthetic and applied value of geometry. Children can estimate price of covering a roof by such slates and also it provides context for the discussion of quadrilaterals, triangles and angles too.
In Gopali community people were found to use a pyramidal wooden frame locally called *filo* to weave woollen threads. The next consisted of skeleton of wood that had a shape of perfect pyramid and it could be used as an artefact in the contextualization of teaching parallel and perpendicular lines.

*Mana* is a standard cylindrical pot made of copper or iron or bamboo to measure grains in both the communities. The system of measurements of volume of grains was eight *mana* equals one *pathi* and twenty *pathis* equals one *muri*. It is a very popular measurement in other cultures as well in rural Nepal. Classroom teaching of mathematics can be enriched by the practices of problem solving related to *mana*, *pathi* and *muri* same as *gram*, *kilogram* and *quintal*.

*When Sarita was asked to tell the geometrical shape of her household goods but she could not understand our question. When Amrit (a field researcher) rephrases the question about the shape of some goods then she wrote on a page that some the goods are nanglo with circular shape, sleeping bed with rectangular shape, ansi with semicircular (crescent moon), and ladder with pair of lines. She was found to helpful to her parents in mathematics of agricultural works and other day-to-day life problem solving through mathematics.*

The experience Sarita had at her home in her day-to-day work while helping her parents could bring a lot of contextual mathematical issues that can be rich source of imparting meaningful learning and teaching of mathematics in schools. Also the set of artefacts with certain geometrical shapes could bring new spices in the classroom geometry for teachers and students.

Counting system in Gopali community is based on base ten system but they use twenty as a basis to count larger numbers. For example when they have to say eighty five they say four twenties and five. The counting of numbers in their language was like this:
Chhugu = one, Ngegu = two, Swongu = three, Pegu = four, Ngagu = five, Khugu = six, Nhegu = seven, Chyagu = 8, Gugu = nine, Jhigu = ten, Jinchhugu = eleven, Jingegu = twelve, Swipegu = thirty four, Sachhi = hundred and so on.

Counting in Tamang community is also based on base ten system. Their counting of numbers is as follows: Ki = one, Ni = two, Som = three, Bali = four, Nga = five, Du = six, Ngis = seven, Bre = eight, Ku = nine, Cheu = ten, Cheu Ki = eleven, Cheu Ni = twelve, Cheu Ku = nineteen, Vogal = twenty and so on.

These practices in both the communities show tremendous opportunities to the children to learn mathematics from their own local sociocultural practices. The curriculum can be contextualized by the concerned teachers if it is emphasized during their training.

**Family Members and Mathematics**

There was a great mathematical craze hidden in the families of Tamang and Gopali community. There was a good sense of responsibilities of each members of their family. The children were found to be relatively obedient to their parents in both the community relative to other communities such as Brahman, Chhetri and Newars.

The members of the families under our study were rich source of contextual learning of whole numbers. Number of family members can be either zero (when all die), one, two, three … and so on. It can not be negative and also fraction. So, information collected in the form of biography of the informants could provide an excellent context of teaching sets, whole number, natural number, sequence and statistics (representation of family members with their age, weight and height and so on). The interest of different family members and their profession also has a significant relation with children's attitude and behaviour and that ultimately affects learning of mathematics by the children.

Sarita Gopali a grade seven student was influenced by her parents in her schooling. She expressed that her mother can read and write. She was much influenced by her mother to study. Sometimes here mother asks her to help her in calculating the remuneration of farm labourers. Then she finds the application of mathematics at home. She feels really nice when her mother tells her to do some calculation for the household expenses and farm works.

Her mother Sakali Maya Gopali says that all girls should be educated and she is happy to send her daughter Sarita to school. Also she feels good when Sarita helps her in household activities and also in some mathematical calculation of expenses in the farming.

Sukuman Thing milks his buffalo and sells it to local market. His wife Maili Thing is a housewife. She says that she is happy to send her daughter to school. Their daughter Asmita Tamang studies in grade seven. She helps her mother in household works. She helps her parents in making food for cows and buffaloes with corn power and rice husks.
She carries water from nearby tap. But she has not been asked to do mathematical calculation at home. She says that mathematics is a hard subject to understand.

The family structure and parents role plays a great role in the education of girl child. Children can not escape from household works but while working and helping their parents they are engaged in mathematical thinking. Sarita and Asmita are the representative of two girls from the two communities. Their family has a great role in the learning of mathematics. Sarita's parents are more educated than Asmita. So Sarita enjoys more mathematical practices at home. The exposure to mathematical calculation at home has helped her to understand the value of learning mathematics. Whereas Asmita seems a bit uncomfortable in the application of mathematics at home.

This shows that family can play a significant role in the creation of learning environment at home for their children. If parents engage their children in some mathematical works at home it helps the children to understand the value of mathematics, application of mathematics in day-to-day life and find some link between school mathematics with out-of-school mathematics.
ANNEX IV : A Grand Tour of Geometry

(Material for Teachers)

We come across various concepts of geometry in our daily life. There are objects and actions that have direct and indirect connection with geometry. These objects or actions have geometrical properties, functions and applications. We would like to invite you to find geometry and its application from our daily life and link them with classroom teaching of geometry.

Geometry in our houses inside rooms, kitchen, roof and artifacts such as doko, nanglo, plates, cooking pots, ghum, spade, halo (plough) and so many others depict rich sources of geometry and its application in our daily life to classroom. From this discussion you will start a practice of bridging the informal geometrical practices in home or culture into classroom teaching so that students not only enjoy the learning but also explore geometry and its application from their daily life.

Part One

Objectives

In this part we aim to assist you in

- developing a sound understanding of concept of lines of different types, angles and some geometrical figures from local practices;
- exploring different types of geometrical ideas from local and cultural practices and link them with classroom teaching of geometry.

Concept of Geometry in Our Daily Life

We perform different works in our daily life. These works demand some ideas of points, lines, angles, and shapes. People are engaged in farming, cooking, washing, constructing and cleaning where there is application of geometry in known form or unknown form. So, what profession we have or what works we do for our livelihood, there is connection of geometry. Now I would like to invite you to explore geometry from the life of people.

Geometry in doko

Tok bahadur ghlan is an ex-army man. He lives at Bajrayogini. He makes nice bamboo baskets (dokos) during his leisure time (look at the figure below). He was busy in preparing a doko from bamboo when I met him last on March 2007.
Look at the *doko*. What different geometries can you see? Yes, there are lines. Some lines are straight and some are curve. Some of the pairs look parallel and some others look intersecting. Some lines are horizontal, some are vertical and some are at a slope with horizontal. There are geometrical shapes of triangles, quadrilaterals, pentagons, hexagons. There are some squares and some figures are rectangles and parallelograms. The *doko* itself as a whole forms a pyramid. What a surprise? Every part of doko is concerned with geometry and it represents a unique geometrical shape in our culture.

**Geometry in halo (plough)**

Now look at the figure below. It is a very popular artifact in rural Nepal especially for farmers. What geometry do you find in it? If you say lines and angles, you are right. The different part of a plough represents lines and they make different angles. What are the different angles? Yes, acute angle, straight angle and obtuse angle.

So, just taking halo, we can explore the concept of intersecting lines and angle between them. Also we can see the effect of changes in the angles between the lines. This provides a practical application of concept of angle and its size in our daily life. Did we ever think
of what should be the angle between fali and harish of a halo? What is the effect of increasing or decreasing the angle?

The wooden plough in the above figure was pictured in Gopali community. This also carries a lot of geometrical meanings that can provide rich context in the classroom teaching and learning of geometry.

**Geometry in a house**

This is a house in Bajrayogini (figure below). You can see different geometrical entities in the house. The geometry of wall, the geometry of roof and the geometry of doors and windows. The wall is made up of clay bricks and it is rectangular in shape. The roof has a slope at an angle with the horizontal line or surface. The pattern of tiles on the roof shows
a great cultural application of geometry in Tamang community. Students can explore angles, patterns and shapes at the different part of the house together with their measurements. This way you can engage students in the discovery of geometrical application in the lives of people in rural areas.

**Geometry in Children’s Game/Play:**

Children in the villages were found to play different games/play after or before school in groups. When I reached Nhul Gaun in Chitlang last year, some children were playing *Ladain* (fight) on a geometrical pattern. That showed application of geometry in children’s games/play. There were various geometrical concepts such as lines, parallels, perpendicualars, squares, rectangles, parallelograms, triangles etc. in the frame they used for playing.

The figure below shows the net that children used to play *ladain* (fight) that has interesting geometrical pattern. The play *ladain* is not physical play but a mental play like chess. It can help a lot in the teaching and learning of mathematics (geometry) in the classroom. The small circles represent pebbles or grains.

Fig 3. Net of *Ladain* (A Children's Game)
Charimaya and her brother playing *ladain*.

**Geometry in Dali (a typical Nepali basket)**

*Dali* is a bamboo basket found in both Gopali and Tamang community. It has four vertical bamboo rods as support and looks pyramid from outside, the top end is circular. The pattern of weaving *dali* shows a great geometrical application of lines, parallels, triangles, quadrilaterals and so on. Its unique pattern of weaving the bamboo pieces gives a beautiful image. It can be helpful to teach geometrical transformations such as rotation and reflection. It is equally helpful to teach line symmetry in grade seven.
Geometry in Nanglo

Nanglo is a popular artifact in every rural Nepali house not only in Gopali and Tamang community. As a whole it is circular disc, inside it there are various geometrical patterns and forms. It not only supports teaching simple geometry of lines, angles, triangles, rectangles but also it supports teaching coordinate geometry too. The horizontal and vertical intersecting lines can be regarded as two perpendicular axes. The beautiful patterns form images around a fixed line as a line of reflection. Also it can be useful in teaching line symmetry and point symmetry.

The Nanglo can be rotated about a fixed point at the center or origin and can be taught the concept of rotation in geometric transformation. At the same time it can be helpful to teach reflection about axes of x and y. There are two sides of the Nanglo. The first picture below is the front or ventral side and the next one below it is the opposite or dorsal side.
The two sides are not identical and both sides can be used for different purposes while teaching geometry with the help of it. 

_Nanglo_ is used for the purpose of winnowing the rice and other grains to separate the impurities from it.
These are some of the examples to see how our life is deeply connected with geometry knowingly or unknowingly. When we travel around a culture, we find wider varieties of geometry and its application in our life. Whether is it dhiki or janto, nanglo or dali, mandro or gundro, bina or chakati …everything has a significant geometric properties that can be used in the classroom teaching and learning.

<table>
<thead>
<tr>
<th>Making Sense of Different Types of Lines and Angles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Of course we come across different objects and activities that deal with various lines and angles. But we do not see them geometrically in a conscious way. These objects and</td>
</tr>
</tbody>
</table>
activities impart a deep impression in the understanding of fundamentals of geometry if we dig them out consciously from the perspective of geometry and its application.

Parallel and Perpendicular Line Segments
There are different objects around us that can depict the notion of parallel and perpendicular lines. In a doko, you can see some parallel lines and some perpendicular lines and even some are transversal lines, or intersecting lines. In a monkey climb (that lies outside of Ugra Tara School), there are parallels and perpendiculars. When two pillars support the roof of a house, these two pillars are parallel and they are perpendicular to the ground.
In the figure below is a Nanglo. It has different kinds of lines (some are parallel, some are perpendicular and some are intersecting).

Angles of different Types
When we look at a house, we can find different kinds of angles formed at different parts. In the house below, we can see the acute angle (1) at the lower corners of the roof with a parallel side roof that form triangle at the face of a vertical wall. Then lower margin of the roof with the corner line of the wall has made the right angle (2). The part at which left and right part of the roof meet each other has formed the obtuse angle (3), the same angle when measured from up (towards sky) gives rise to the value of reflex angle(4). The tokro in the second figure is also useful to teach the concept of acute angle, right angle, obtuse angle, straight angle and reflex angle.
How did you feel after reading the above contexts? At this point you might have started thinking about different lines and angles in our daily life. In a house you saw different angles, in a tree with branches you can see different lines and angles, in an artifact such as doko or ghum you can explore so many types of angles and lines. In this regard, we would like to invite you to consider the local practices of geometry as a starting point for discussion of any geometry in the classroom. This can help your students to develop conceptual understanding of lines, angles and other sections of geometry from cultural background. They also start valuing their own practices and informal experiences as a basis to learn geometry in the classroom.
Geometry of lines, angles, shapes around us can be a very powerful tool to teach geometry. We hope at this point that you will start linking the local context to the classroom teaching of geometry. You can think of and show various examples of geometrical structures while discussing lines, angles and shapes in the classroom. We would like to invite you to next section of this discussion in which you will review a sample lesson plan to teach the concept of different types of angles in grade six.

**Part Two**

**Objectives**

This section aims to assist you in

- developing student friendly locally contextualized teaching-learning method on the topic of types of angles.

**Exemplar Daily Lesson Plan**

When viewed carefully, there are different angles around us in different artifacts such as doko, ghum, ping (swing) and houses. Here we have tried to help you to see the context of cultural and daily life while teaching types angles in the class (grade six). This plan is only a model but not the ultimate. It intends to contextualize teaching different types of angles with examples from daily life and cultures. This focuses more on exploration by students rather than traditional way of teaching by writing on the board. The lesson has five parts that flows in a sequence.

**Objectives of the day**

By the end of this lesson, students will be able to

- Collect various examples of angles and their types from their local context.

- Classify the angles based on their size or measurement.

**Materials**

- Picture of house
- Doko
- Ghum
- Other artifacts as available in the local context
- Student reading material

**Activities:**

<table>
<thead>
<tr>
<th>SN</th>
<th>Student Activities</th>
<th>Teacher Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Students reciprocate the greeting. Students then try to guess from the picture about the day’s discussion.</td>
<td>The teacher enters the class and greets students. Then he/she demonstrates a picture of a house. He/she asks them to guess what they are going to discuss on that day.</td>
</tr>
<tr>
<td>2.</td>
<td>Students explore the different angles from the different parts of the house.</td>
<td>He/she asks them some questions about geometrical patterns that they can predict from the picture of a house focusing more on angles. He/she writes the major points told by students on the chalkboard.</td>
</tr>
</tbody>
</table>
3. They start solving the problem individually. Students observe the picture of a house demonstrated by the teacher and note the different parts with corresponding angles. Each of them make a list of part of the house in the picture with different angles (they can draw figure too).

He/she then gives them a task do in the class. Note the different kinds of angles from the structure of the house in the picture and part of house where you find these angles.

4. Students then discuss about different kinds of angles with reference to different parts of the house. Each group answers the question posed by the teacher. When they can not tell the answer immediately, they seek some time for further thinking. They talk in group about the effect of changes in the angles at the different parts of the house. For example: when the wall makes right angle with the surface floor, then it can not be changed. If the wall makes more or less than 90 degree angle with the floor the, wall can fall down at any time and the house is not safe … or like this.

He/she tells them to discuss in group when they finish their solution. The teacher asks them the questions to groups:
   (a) Which part of the house do you find acute angle?
   (b) Which part of the house do you find obtuse angle?
   (c) Where do you see right angle?
   (d) What happens if these angles are changed (increased or decreased)?

5. The teacher gives a small model of a doko, ghum and kocro (chicken basket) in groups of five or six. Then he/she asks them to find different kinds of angles at different parts of these artifacts. He/she gives them a sign pen to mark the angles in the artifacts.

Students make presentation of their solutions group-wise. They will specifically name the angles (a) acute angle (b) right angle (c) obtuse angle (d) straight angle and (e) reflex angle pointing from doko, ghum and kocro.

He/she encourages them to speak more to explain the findings from their observation on those artifacts.

6. The teacher summarizes the day’s lesson with explanation of different kinds of angles from the objects around us.
Student Assessment: Generally you can assess students using a variety of techniques. For your help, two modes of assessment have been suggested here:

In-class assessment:

a) You can ask some questions demonstrating the part of the house in the picture you already demonstrated and ask them the question: What angle does this part have? You can point at different part of the classroom and repeat the same question.

b) You will assess individual students on the basis of your observation during their activities in the class. The following table might be a help.

<table>
<thead>
<tr>
<th>Name of student</th>
<th>Contributed ideas</th>
<th>Participated actively in the group work</th>
<th>Demonstrated creativity</th>
<th>Raised questions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3</td>
<td>1 2 3</td>
<td>1 2 3</td>
<td>1 2 3</td>
</tr>
</tbody>
</table>

1 = rarely; 2 = sometimes; 3 = always

b) Post-class assessment: You can assign some tasks which they bring into the next class. The following can be an example:

- Identify acute angles, right angle, obtuse angle, straight angle and reflex angle from the following context and make a chart of these angles.
- Observe an artifact at your home and discover different kinds of angles.

You can use the following rating scale for marking/grading your students’ task:

4 - Excellent
3 - Good
2 - Satisfactory
1 - Needs improvement

Sample Student Project

Projects can be given to students in order to enrich their conceptual understanding of the different kinds of angles and their application in our daily life. We would like to encourage you to design and give projects to students to discover various types of angles from their local context. The project work has been designed in a way to make it flexible enough so that it can be modified in to a suitable from in any context.

Different Angles in a Temple or Gompa

Overview of the Project: This project intends to engage students in the rediscovery of different kinds of angles from their cultural context. They will visit a temple or Gompa near by their village. They will explore the existence of different types of angles in the different parts of the temple. They will then write a report of their observation and findings and make a presentation in the class. They will work in the groups of five or six. They will be involved in the visit to different temples or gompas by each group. The final report will be published in the school wall-magazine.

Objectives of the Project

As result of participation in the project, the students will be able to

- develop deeper understandings of the concept of angles;
- explore different types of angles by observing local temples and gompas;
Responsibilities of stakeholders

Students: Students will be responsible for the overall planning and implementation of this project. Their major responsibilities are:

- planning of the project,
- visiting local temples and gompas as required,
- collecting information from the observation of the site,
- completing the assigned task,
- preparing a brief report, and
- making presentations

Teacher: Your role is very important in facilitating and helping students to progress well with the project. Perhaps, you need to develop a view about your students as ‘young and collaborating mathematicians’. On top of this, some of your major responsibilities are mentioned below:

- facilitate students to get ready for the project,
- provide timely and constructive feedback to their tasks,
- help identify possible sites to visit, and
- help make necessary arrangement for students’ field visit.

Maximum Project Members: There can be as many students as you can observe and provide them with just-in-time support for their task. We suggest making relatively small groups not exceeding five/six members in each.

Duration of the project: Generally, projects that can be accomplished in a short duration are more appropriate because students at this level may not have patience to cope with the project that has a long duration. For this project, I suggest the duration to be one week to two weeks.

Project Activities

1. Planning of the Project: Students together with their teacher plan their project on the basis of following four questions:

   - What is the major focus of the project? The major focus of this project is to find out and record different types of angles in the different parts of temples or gompas.
   - Who will be involved in the project? The project will be undertaken by the students. Primarily students will take a lead whereas the teacher has to provide them with necessary guidance, feedback and support.
   - When to start and finish the project? In the case of this project, the time period is one week to two weeks. However, you can adjust the total time period according to the local needs and context.
   - How to execute the project? The starting point of the execution of this project is forming a number of groups from the whole class. Each group can be a maximum of five/six students. Having done this, the teacher and students need to be clear about the source of information and methods of obtaining the required information for the project. In this project, students will seek information from the local temples or gompas. In a nutshell, they will observe different parts of the temple. Specifically, each group of students needs a clear plan about where and
2. **Fieldwork Activities**: On the basis of their plan, students can start collecting information. In the present project they will collect information regarding different types of angles. While students are doing their fieldwork, it is better for you to organise meetings with them and have discussions about issues that need to be resolved. In this process you will actually know what is happening, and the kind of support they need from you.

3. **Organizing the Report**: It is always good to have a record of what has been done. In their reports, students can mention procedures, results, and their learning from the project. In this process, teacher’s help is crucial because you need to help them to finalise their report.

4. **Publicizing the Report**: Each group can make a chart explaining ‘what was the topic of their project?’, ‘how did they undertake it?’, ‘who did they work with?’, ‘when did they start and complete the project?’, and ‘what did they explore?’ and present it as part of the ‘wall magazine’ of their school.

**Assessment Strategy**

Such a project requires individual and collective efforts to accomplish it successfully. Therefore, it is better to assess students on the basis of their group and individual performance. It is also essential to make students aware of the assessment criteria before starting the project.

The following criteria can be useful to assess the group:

<table>
<thead>
<tr>
<th></th>
<th>Planning 1</th>
<th>Planning 2</th>
<th>Planning 3</th>
<th>Fieldwork 1</th>
<th>Fieldwork 2</th>
<th>Fieldwork 3</th>
<th>Reporting 1</th>
<th>Reporting 2</th>
<th>Reporting 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group One</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Group Two</td>
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<td></td>
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</tbody>
</table>

Assessing the individual also requires a set of criteria. You can use the following table as a basis:

<table>
<thead>
<tr>
<th></th>
<th>Individual contribution in planning 1</th>
<th>Individual contribution in the Fieldwork 1</th>
<th>Individual contribution in reporting 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student 3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: 1 = needs improvement, 2 = moderate, 3 = excellent
# Geometry in our Daily Life

## (Student Reading Material)

### Objectives

Through this reading material we would like to help you in
- developing the conceptual understanding of an angle from the local context.
- searching different kinds of angles and geometrical shapes from the local context.
- create poems, stories and dialogues while learning geometry and demonstrate this in classroom discussion on lines, angles, geometrical shapes etc.

### Concept of Angle

You might have heard about angles in geometry. It can be frequently heard when people are playing carom on a board. They talk about angle when they are going to build a house. They talk about angle when they are going to build a road or canal at local level. Even it may come during making of a *doko, mandro* or *ghum*.

What is an angle? How an angle is formed? Where an angle is formed? What is practical significance of knowing angles and their properties? These are some of the questions that we have to learn while discussing the concept of angle.

Following is a letter by Urmila to Sarita. She talks about how she could explore different kinds of angles from a house during her local tour with her classmates and mathematics teacher.

Dear Sarita,

I am a student of grade six in Nateswar High School at Taukhel, Chitlang. Last time we went to find angles and their types in our village. At first we were surprised to listen that we were going to find geometry in our locality. I thought that geometry was in our mathematics book and how it can be in our village. Lines, angles and shapes all are the subjects in our book but after this geometrical tour, I am surprised.

Last week our mathematics teacher (……) took us to a house in our village. The house belongs to a man who is a farmer. We observed the house from outside. We had camera to take photographs, ropes to measure the length, protractors to measure the angles.

Oh! What a surprise! We found angles at each corner of the house. We found angles at the top where two part of roof met each other. There was an angle where one wall met with next wall, there was angle where a support beam met a parallel beam at the underneath of the roof.
There was a ladder in the house to go up. We observed the ladder. There was one ladder at
the back of the house. We asked the house owner that what was the use of ladder outside at
the back of the house. He explained that he used the ladder for picking up vegetables, colour
on the wall and put maize at the parallel beams from outside. The ladder was good to
explore parallel lines and transversals. Also it could be placed at different angles to the wall
and accordingly could be climbed up and down easily.

We went to see a temple in the village. There were different kinds of angles at the meeting
point of two roofs, two pillars and beams. We were very much excited to know that there
were different kinds of geometrical objects in the different parts.
Then we went to visit a gompa near our school. We had not noticed that the gompa and temple can be an object of mathematics. Since our last visit to them I am very happy to find various kinds of angles in the houses, temples and gompas. This tour became a very helpful for us to find the value of knowing mathematics, how to explore geometry from our own life and practices.

Now the letter became a bit longer. I hope you enjoyed reading it.
Looking forward to receive your letter,
Sincerely Yours
Urmila Gopali
Nateswar High School
Taukhel, Chitlang

**Tasks for You**

Now discuss in pair with your friend on the following questions.

1. What are different objects have been discussed in the above letter?
2. What kinds of angles have been explored by the students when they went to see a house in the village?
3. Write a letter to your friend about different kinds of angles that you explored during a tour to a carpenters shop in your village.

**Exploring Different Geometrical Shapes**

We see different kinds of objects around us. These objects or artifacts have geometrical shapes such as lines and segments (curve and straight), parallel and perpendiculars, intersecting lines, triangles, quadrilaterals of different kinds, polygons and circles. The series of photos from one to ten depict the existence of geometrical ideas and concepts in our daily life consciously or unconsciously.

When you open your book to study lines (curves and straight), then you might have drawn such lines with pencil, scale and compass. We can find the notion of such lines in the
artifacts such as monkey climb, slide, swing, *doko, nanglo, dali* and other different artifacts that we use at home.

Now, we would like to invite you in a picture show in which you will identify different geometrical concepts that are linked with our mathematics textbook or curriculum. The following pictures demonstrate the possibility of exploring geometrical ideas from our home and community. Will you please go through each picture or photo and note what geometrical concepts you find that you have already studied or are studying at the moment or will be helpful for future study.

You can share your ideas with your friends in group and finally you can share in the whole class.

Photo 1

Photo 2
As you saw different geometrical shapes from the above photos and also you read a letter from Urmila to Sarita, you might have come to realize geometry from our local context. It is not that we are leaving our textbook but we are trying to connect it with our local context of learning geometry through examples and practices from our culture and daily life. Now perhaps you have started viewing geometry in most of the things directly or indirectly. It is now time to think how to link our classroom practices with such daily life events and
Conclusion

This is the end of the grand tour of geometry. This grand tour might have helped you to understand the concept of lines, angles, and different geometrical shapes. In fact, the photos of artifacts have created context of searching geometry from around our house and culture.

Your own family and home provides wider opportunities to learn geometry and its application.

Slide in the first photo provides context of learning lines, slopes and their effects in the slide and its functioning. The second photo of monkey climb can be helpful to learn about parallel and perpendicular lines and their application in our life. The third photo shows construction of a building in Ghumarchowk in Bajrayogini. It has again the parallels and perpendiculars. The fourth photo is of beams and support from below the roof of Ugra Tara Lower Secondary School at Bajrayogini. The concept of acute angle and right angle and their application can be taught with such examples. The fifth and sixth photos depict how geometry comes in application while making a doko from bamboo pieces. You may notice lines, angles, triangles, rectangles, parallelograms and polygons such as pentagons and hexagons. The seventh photo is a kocro in which chickens have been kept. There are beautiful geometrical patterns of hexagon in it. The eighth photo is a bamboo support for the scoosh (squash) plant. There are also concepts of parallels and perpendiculars in it. The ninth pair of photos is the collection of nanglos (Winnowers) and these are very famous artifacts not only in Gopali and Tamang communities but every house in the rural Nepal. These nanglos at a glance gives us the concept of circles. When we observe them deeply, they have great geometrical significance.

Finally the tenth photo is of a chakati (mat) made of cover of maize. This has a circular shape but its structure shows that people weave it with unconscious application of geometry starting from four quadrants (cross section of two threads).

In this way you can see geometry in different kinds of artifacts at home and in your community. You can see people using geometry in a way different from what we discuss in the classroom and what is discussed in the textbooks. The connection of geometry in our daily life with classroom mathematics can be fruitful for us as it helps us to see direct application of geometry in our life.
हामी जीवनमा धेरै ज्यामितीय अवधारणाहरू लागै छौ । हामी जीवन र ज्यामितीसंग सोभै वा घुम्ने सम्बन्ध राख्ने धेरै वस्तृ र धेरै कायम छौ । यस्ता वस्तु र धेरै कायम ज्यामितीय विशेषता, कायम र उपयोग छौ । हामीले तपाईंलाई यहाँ धेरै कायम जीवनमा आउने ज्यामिती र त्यसको कक्षाकोठामा प्रयोग गर्नका निम्न निम्न उदाहरणहरू ।

उदाहरणहरू-
यो भागमा हाम्रो लक्ष्य-

• तपाईंलाई विभिन्न प्रकारका रेखाहरू, कोणहरू र केही ज्यामितीय अवधारणा गाउँछिएको परिवेश वुम्न सहयोग पुनः सहयोग पुनः हो ।

• तपाईं विभिन्न किमिसको ज्यामीतिप्रेरित जूक्सहरू गाउँछिएको परिवेश र साँस्कृतिक अवधारणासँग निकाली कक्षाकोठामा छलफलभएको सहयोग पुनः हो ।

ज्यामितीको भ्रमण
हामी धेरै कायम जीवनमा ज्यामिती विभिन्न रूपमा आउछ। मानसहरू खेती गर्न, पकाउन, सफा गर्न, कपडा धुनै, घर तथा भवनहरू बनाउन लागि रहेको हुन्छ ० जहाँ ज्यामितीको शात्रो र अज्ञात रूपमा प्रयोग भएको हुन्छ ।

हामी विश्वास भएको विहीनहरूलाई धेरै विचारहरू अवलोकन गरि विभिन्न प्रकारका ज्यामितीय आकारबाट छलफल गर्न आङ्गन गर्दछ । यस क्रममा विन्दु, रेखा खण्डहरू, कोणहरू तथा विभिन्न प्रकारका ज्यामितीय आकारहरू पता लगाई शक्तक तथा साइंससंगो छलफल गर्दै राम्रो हुनेछ ।

अतिर विश्वास भएको विहीनहरू, तिमीहरू ज्यामितीको भ्रमण निम्न तयार छौ होला । यस भ्रमणको सिकेर कुराई तिमो पुस्तकमा भएको ज्यामितीय समस्याहरू समाधान गर्न सहयोग पुन्छ ।
डोकोमा ज्यामिति-

हलोमा ज्यामिति
घरमा ज्यामिती-
खेलमा ज्यामीति (लडाई खेलको नक्षा) -
नाङ्गलोमा ज्यामिति-

कोकोमा ज्यामिति
स्कुस खेतिमा ज्यामिती

सारांशामा
हाम्रो वरिपरिका आकृतिले ज्यामिती सिवनमा शक्तिशाली साधनको कार्य गर्दछ। तिमीहरूले यो क्षणमा आएर स्थानीय परिवेशमा कक्षाकोटामा जोडी ज्यामिती पहुँच्नेछौं भन्ने कुरा हामीले आशा राखेका छौं।
अब विचार गरा:
- डोकोमा कस्ता ज्यामितीय आकृति पाउँ?
- हलोमा कस्ता ज्यामितीय आकृति पाउँ?
- धरमा कस्ता ज्यामितीय आकृति पाउँ?
- लडाइ खेलमा कस्ता ज्यामितीय आकृति पाउँ?
- नाइलोमा कस्ता ज्यामितीय आकृति पाउँ?
- कोकोमा डोकोमा कस्ता ज्यामितीय आकृति पाउँ?
- स्कुस खेतिमा कस्ता ज्यामितीय आकृति पाउँ?

तिमीहरूले छलफल गरेका कुरा ज्यामिती सिवन सहयोगी भए होला भन्ने आशा राख्दछौं।
ANNEX V: Parental Awareness Material

हाम्रो दैनिक जीवनमा गणित
(अभिमावकहकला लागि)

1. साधन परिचय:
नमस्कार!

आदरणीय अभिमावकहकलाई हाम्रो दैनिक जीवनमा भैरहने कियाकलापसंग सम्बन्धित गणितको विवरण छलफल गर्नका लागि आमन्त्रण गर्दैछ। हाम्रो बास्तवमा दैनिक जीवनमा विविध कियाकलापहरू सहभागी हुन्छ आएका छौ। जसले- खाना पकाउने, सरसफाई गर्नेको लागि सामग्री, बाजारमा खरीदाउने, निष्पादनहरू बजारमा वस्त्र खरीद्ने र वातावरणहरू अभ्यास गर्ने जसले हाम्रो जीवनमा सहभागी हुने भएका हाम्रो दैनिक जीवनमा अभ्यास सँग्रहीत गर्ने वातावरणहरू झाप्लाई अभ्यासको र प्रयोग हुन्छ। हाम्रो दैनिक जीवनमा शक्ति र सबै सब गर्ने लागि कलर्जी विचार गर्नुभएको छ कि? अभिमावकहको रूपमा हाम्रो भूमिका लाई हाम्रो बालवालाकोले गणित विविध क्रममा र विविधप्रकार बढाउँछ भने अाशा राखेका छौ। गणितको संबन्धमा हाम्रो दैनिक जीवनमा शक्ति र सबै सब गर्ने लागि कलर्जी विचार गर्नुभएको छ कि? अभिमावकहको रूपमा रूपमा हाम्रो नेपाली भाषामा हाम्रो बालवालाकोले गणित विविध क्रममा र विविधप्रकार बढाउँछ भने अाशा राखेका छौ।

यहाँहरू हाम्रो घर, खेतीपति, बजार सार्थक यसले अन्य कुरा जस्तमा हाम्रो शहरभागी भएको विविध कियाकलापहरू गर्दछ। तीसरंग गणितको कस्तो सम्बन्ध होला भने विवरण चिनलन्छ गर्नका लागि विनिमय अनुरोध गर्दछ। यहाँलाई लागि यसबी आफ्नो सोचेमा हाम्रोले गर्नु छ र बा को काम लागाव र। अबाबन्ने यसले यहाँको त्यसै सोचिएल हाम्रो बालवालाको गणित विवरणको अभ्यासमा पन्न ठेक गरिएको भने आशा राखेका छौ। गणितको संबन्धमा हाम्रो दैनिक जीवनमा शक्ति र सबै सब गर्ने लागि कलर्जी विचार गर्नुभएको छ कि? अभिमावकहको रूपमा हाम्रो नेपाली भाषामा हाम्रो बालवालाकोले गणित विविध क्रममा र विविधप्रकार बढाउँछ भने अाशा राखेका छौ।

2. उद्देश्य:
यस छलफलको प्रमुख उद्देश्य यहाँलाई हाम्रो दैनिक कियाकलापहरू र गणितको संबन्ध बेच्र आमन्त्रण गर्नु र हाम्रो भाषामा बालवालाकोले गणित राम्री सिम्ने क्रममा कस्तो सहयोग गर्न सक्कौ भने दुरुपर्यायको समाधान खोज्न सहयोग गर्नु हो।

3. हाम्रो दैनिक जीवनमा गणितीय अभ्यास:
निगराहरू छन् भने भने हाम्रो जनाउँछ सिम्ने क्रममा गणित राम्री सिम्ने क्रममा सहयोग गर्न सक्कौ भने दुरुपर्यायको समाधान खोज्न सहयोग गर्नु हो।
चौतारो मरमत इल्यानीमा गणितको प्रयोग प्रचुर मात्रामा भएको पाउँछ । के हामी यी कियाकलापहरू गर्दै नितमा भएको गणितीय सीपको दर्शाउने गम्भीर भए सोचेका छौ । अब हामी हाम्रो दैनिक जीवनमा हुने वा गर्ने कङ्कालापहरुमा गणितको सम्बन्धवार े छौ ।

- **भाषा कोझा:** भाषा कोझाको दरअस्तिम पकाउने भाषाहरू, बलाहरू, गिलासहरू, डाडु-पन्नूर्दिख काटने सालन्च भर (हिएका, चुलेका) राख्छ।

  यसै गरी भाषासंग भाषामा मसलाहरू, अन्य (चामल, पिठो), तरकारीहरू, नृत, तेल इत्यादि हुँछु । हामीहरू व्यस्त सामान्यश्लाई वर्गीकरण गरेका, नापै, छवियावर वा मिसालहरू, परीक्षण गरिएका राख्छ । यी कियाकलापहरू वस्तुमा गणितीय कियाकलापहरू हुन । यसैले हामी भाषा कोझामा धैर्य गणितीय कियाकलापहरू हुने कुरालाई प्रयोग पाउँछ ।

- **सुन्दर कोझा:** हामी सुन्दर कोझामा कस्ता गणितीय अभ्यास वा प्रयोग हुन्छु ती कहलाउँछ सोचनु भएको छौ । हो, लाईदान खाट र विवर्धनालाई डिजाइनर्दिख लिएर तिनीहरूलाई करा फकोलाई, कसरी सजाउने र भण्डार को तृतीयाको कौट्याको वा निजक राख्ने भएको कुरा हामी विचार गर्दछ । त्यसै अनुसार सुन्दर कोझालाई सजाउन । यी सबै कियाकलापहरूले सुन्दर कोझामा पनि गणितको अभ्यास र प्रयोग भएको कुरालाई ेर दफ्त राख्छ । सुन्दर कोझामा भएका अन्य फन्चिएर र समालामा सजाउने चित्रहरू र रहितको राख्नुहोस् कसरी गणितीय रोमा र प्रयोग फल्काउँछ ।

- **बुजीश्:** के तपाईहरू हामी आफ्नो बैगचामा गएर रमाउने गरेका छौ । अब यसै पनि त्यसै गएर रमाउने हुँछ। तर के हामी त्यसर्विधानमा त्यसै भएका रूङ विस्तारहरूलाई नियालिङ हेतै गणितीय रुपमा सोचेको छौ । बैगचामा भएका विविध बॉटिकर्हरू लगाउन, तिनीहरूको स्थाप र सद्भाव गर्नु हुँकाउन, तिनीहरूलाई कै दुरीमा रोपने, किसिमि दिनाको सङ्ग र पनी दिने र बेलाबेला आफ्को उत्पाल गरेको हामी योजना बनाउछ । यसैले हामी बैगचामा गरिएको कियाकलापहरू प्रकाश्य गणितीय अभ्यास भएको कुरा देखाउँछ ।

- **खेतीपती:** हामो खेतवारीमा गरिने कार्यक्रम प्रकाश्य गणितीय अभ्यास भएको हुन्छ । खेत खाने र जोडेखिए लिएर बीउ छन । पनि र पाँच खाने, बेलाबेला गोदामेको वा उपचार गर्ने कार्यक्रम गणितीय अभ्यास भएको हुन्छ। ती कामहरू गर्न हामीले हाम्रो खोज र साबूढकाम भएका रुपमा सदयोग गर्न सचेत रुपमा योजना बनाउने र त्यसै अनुसार कार्य गर्न गर्दछ । खेतवारीमा बीउ छर्न हामी जलबाबाही छर्न । वर एउटा विवर्धन अन्तर्गतिस्वास्थ्यको दुरीलाई अन्त जारी गरेका भएको निम्नलिङ उपचार गरिएका रुपमा प्रयोग गर्दछ ।

- **घरालपाइ सरस्मनाह:** हामी यहाँहरूलाई आफ्नो घरमा प्रयोग हुने वा बनाइने सामग्रीहरूबाट विचार गर्न र त्यसमा कैस्ता गणितीय सीपको प्रयोग भएको छौ । हामी स्वयं यहाँ घरमा प्रयोग गर्न सामग्रीहरू निर्माण गर्न प्रयोग वा अनुसार रुपमा गणितीय सीपको गर्न रुपमा प्रयोग गरेका हुन्छ। यसैले हामी आफ्नो प्रयोग गरेको गणितको विवरण आफ्नो उपचारक रुपमा अभ्ययन
नगरेका पान हुनसक्छौ। हामी मान्द्रे, गुद्द्रे, चकटी, पिकौं, नाडां, डोको, हलो, कोदारो साथी होसमा, झुकुरी सवेमा गणितीय अभ्यासलाई फलनाउने आकार प्रकार र डिजाइन प्रचुर मात्रामा पाउँछ।

डोकोसंग हामी सबै राम्री परिवर्तन नै छौ। किनकी यो नेपालको हरेक भागमा प्रयोग हुने बास्याल हुनले एउटा भारी बीको साधन हो। तालका घानसृ डोको बुन्नै तलनी हुनुभएको कुरा देख्न सकेको छ। उहाँले डोको बुन्दा प्रत्यक्ष वा अप्रत्यक्ष रूपमा गणितको प्रचुर मात्रामा प्रयोग र अभ्यास गर्नुभएको कुरा उहाँको कलात्मक शैलीवाट प्रभु हुन्छ। उहाँले कितॊ बास्याट कार्यबाट डोको बुन्नै सकिन्छ भनेदैह्नुसै लिएर बास्यका चौहार कसरी जोडिने, कलावट घुमाउने र कसरी आकारमा लेजाने भने कुरा निकको शुभ रूपमा प्रयोग गरनुहुन्छ। यसले उहाँको यस कार्यमा गणितीय ज्ञान र प्रयोगलाई छत्तै पार्को कुरा देखाउँछ।

• किनेबेचो कार्यः हामी दैनिक जीवनमा अफूलाई चाहिने कुराहर सबै हामी आफे उत्पादन गर्न सकिन्छ। हामीले चाहिने केही कुरा आफे उत्पादन गर्नी भने अन्य कुरा हामी अस्वाद किन्छ। आफे उत्पादन गरेका कुरा वा आफे सीप र परिभ्रम अस्वाद विचित्र गर्न र त्यस्याट आफीको पैसावाट अफूलाई चाहिएको कुरा किन्छ। यी कुरावस्था यस्तक वा अव्यवस्थ रूपमा गणितको प्रमुख प्रयोग र अभ्यास भएको हुन्छ। हामीले आफूलाई भएको डाल, बाढङ, तरकारी, फलफल आदि विचित्र गरेका आफीको पैसावाट अफूलाई चाहिने सावन, चिनी, आभित, नून, तेल एत्यादि किन्छ। यी कियाकालपहरुमा हामीले गन्ने, तौलने, नानामा, छूटराउने, जोडने, घटाउने, गुण र भाषा गन्ने जस्ता गणितीय प्रयोग र अभ्यास गर्न।

4. हामी हामी बालबालिकाहरुले गणित सिन्ने कुरामा कसरी सघातुः?

हामीले माध्यम नै छत्तै गर्न सकिन्छ कि गणित हामी जीवनमा हरेक कियाकालपार्से जोडिएको हुनै। जस्मै: मान्यता, सुल्नोको, वैदिक, वेतवारी, किनेबेच इत्यादी सवेमा गणितको महत्वपूर्ण स्थान हुनेछ। अब हामी तपाईंलाई आफी बालबालिकालाई गणित सिन्ने कसरी सघात्न सकिन्छ र भने विविध चल्र गरी। तपाईंलाई ऩाँग सक्छ हामी दैनिक कियाकालपार्से वेदन्त कुरावस्था कसरी हामी बालबालिकालाई गणित गर्नुभएको सकिएला र। तर अव्यस्थ हामी त्यस्ता सामान्य घरायसी कामकाज गर्दै पान गणित सिन्ना वा सिन्ने कुरामा सघातुः।

एकैदै एकै हामी आफी भान्ना कोडमा फककौं। जब हामी खाना पकाउँ रहेका हुन्छ। त्यस्तै खाना पकाउँने, नानामा, भईने तरकारी फ्याउने, कुरा पकाउने, नानामा यस्ता कसरी सघात्न हुने । तपाईंलाई ऩाँग सक्छ हामी त्यस्ता कसरी सघात्न हुने। तरकारी पकाउँने, सघात्न हुने तरकारी फ्याउने, नानामा सघात्न हुने। तर त्यस्ता कसरी सघात्न हुने। तर त्यस्ता कसरी सघात्न हुने। तर त्यस्ता कसरी सघात्न हुने। तर त्यस्ता कसरी सघात्न हुने।
कार्यमा गणितको प्रयोग भएको हुन्छ। तर के हामी वालवालिकालाई गणित सिकाउने थैप्ले हामी उनीहरुलाई त्यस्ता कार्यमा सहभागी गराउँछ। यस्ता कार्यमा उनीहरुलाई सहभागी गराउँछ हामीलाई काममा सघानुका साथै उनीहरुको गणितीय स्थान सोचने, तरबधि र निर्णय गरेको यामतामा वृद्धि हुन्छ।

के हामी सावृज, चिन्नी बा तेल किन्तु आफ्नो वालवालिकालाई पस्लमा पढाउने गर्ने? अबशय हामी भिडै गर्ने उनीहरुलाई त्यस्ता कार्यमा लगाउँछ। तर के हामी उनीहरु त्यस्ता कार्यवार गणित सिकृत भने कूरे कार्य सचेत छौँँ तृतीय स्थान भने निर्णय गरेको उनीहरुको उपयोग पाइ गर्न सक्दृह।

वालवालिकालाई खेलाँदा गणितसम्बन्धी धेरै जान र शीष सिकिरहेको हुन्छ। के हामी त्यस्ता कूरा सचेत छौँ न। हामीलाई लागि सक्दृह खेलेखेर उनीहरुलाई समय धारी वांदा गरेको छन् बा धर्म कामवाट छन् खेल टाढा टाढा पुछ्न्। तर खेलावट उनीहरु धेरै कृपा सिकिरहेको हुन्छ। छैक खेलावट वहाँहरुलाई धैर्या हो। उनीहरु छैक खेल खेल्दा भूमिमा ठेक्का कोनिक, खेल्दा समूह वनाउने, छन्दे र आफ्नो पक्षावाट कसरी जिताउने भने तरक गर्न सक्दृह। यी सबै गणितीय हिसाबले महत्वपूर्ण कुरा हुन। खेलावट वालवालिकाको शारीरिक र मानसिक विकास हुनुका साथै गणितीय स्थान सोचने बालीको विकास हुन्छ।

यसरी हामी सिकिर प्राप्त सूचना, धर्म, तरक र सकारात्मक सोचाइको विकास गरेको कूरा फाल्दा सघानु र व्यस्त गर्न जस्ती पनि हुन।

५. हाम्रो जीवनमा गणितको भूमिका

माथिको छलफलवाट यो प्रण हुन्छ र गणित जताताले व्यङ्ग छ। हामीले माथि नै छलफल गर्नु पार्न यो वालवालिकालाई गणित कियाकलापमा, सहभागी गरारेको विभाग। तरिकालाई गणित सिकिर सक्नु, भने देखाउँ सक्नु। उनीहरुलाई आफ्नो प्रकार विन्ज र छलफल गर्न लगाउने, क्रम निर्देशमा लगाउने, बस्तहरुको नापस्त मूल निर्देश, त्यसका आधारमा किनेको गर्ने कार्यमा वालवालिकाले आफ्नो मापन गर्ने निर्णय गर्न सक्दृह। हाम्रो जीवनमा गणित कहाँ कहा ४२ भने कुरा उदयर्याट तरको व्यवस्थाव्याप व्यङ्ग सक्नु।

• समस्ता समाधानमा गणित: दैर्थिक जीवनमा आइपने धेरै समस्याहरु समाधान गर्ने कूरा गणित आउँछ। हाम्रीले आफ्नो भएको रू.२०,०००ले एउटा दुवौ बैसी किन्ने र बा एक हल गोरौ किन्ने भने निर्णय गर्दै हुन्छ भएको प्रभाव आफ्नो गर्न भत्क।

• एक छलफल लगाउनु चाहिं न। हाम्रीले धेरै गोरौ किने भने कुरा कुनावट बढी। फाइल्ड लिम सक्नु भने कुरा सम्बन्धमा विचार गर्न। दुवौ बैसी किने बाल समाधानमा हाम्रो रू.३०,००० आफ्नी गर्न सक्दृह भने एक हल गोरौ किने जम्मा रू.१८ हजारको आवाहन गर्न सक्दृह सम्बन्धमा विचार गर्न सक्दृह। अभि त हाम्री सिलेट
• जीवन निर्वाहका लागि गणित: एक दिन हामीले एक जना भरिया दाल्ने सांपेड़ख मध्ये धुमार चोकसमा भारी ल्याउने गरेको देखि। उहालाई हामीले उक्त भरी कतै तौलको छ र कुन हिसाबले पैसा लिनु हुने भन्दा पनि सोध्न। एक छिन त उहाँ केही बोल्नु भएन। फेंकि विस्तारी भन्नुभयो धानीको पांच रूपान्। मेसा भारी ३० धानीको छ र यसबाट मैले र७५० पाउछु भन्नुभयो। यसबाट उहाँको जीवन निर्वाह चलेको छ। यद्यपि उहाँले हिसाब गर्न नजारेको भए उहानलाई ल्याउन्दा धेरै पैसामा भारी बोल्नु पर्याय र जीवन निर्वाह गर्नु भन्ने गर्ने हुने दिखो।

एक दिन डोम्यालाई बुझारे रु.१०० दिए प्रेंटो लाबेलहरू भए। डोम्याले र१२ रो दानु फिन र र७० फिता पाइन। उनले पैसा दिए हिल्ने लगाइ विनिंग फेर अड़िए पैसा गनिको। उनी पस्तलिंग फिकिया साहित्यालाई अरू र२० नुपर्ने छुरा बलाई। साहित्य फेरि पैसा गनेको हेरे र साँचे र१० रूपान् पल्लेर्ने रहेको छ र भन्दा धेरै रु.१० दिए पछाइ। यस कथामा डोम्याले आफ्नो गणितीय चेतनाले उजागर गर्दछ। उनले अडिे पैसाले एक दिन हिसाब नजाररको भए साहित्य रु.१० घो।

यस्ती प्रणालीले जीवन गणित: देखि वाले नागरिकका हैसयतले हाम्रो उत्तराधिकार के हुन सक्छन् त। एक दिन विचार गर्न। हाम्रो कसरी एटो अन्य नागरिकको भूमिका निर्वाह गर्न सक्छ। गणितको यसमा भन्नु मूँका हुन सक्छ। यी केही महत्त्वपूर्ण प्रश्न हुन्छ जसमा हाम्रो विचार गर्न पर्दछ।

• नागरिकताका लागि गणित: देखि वाले नागरिकका हैसयतले हाम्रो उत्तराधिकार के हुन सक्छन् त। एक दिन विचार गर्न। हाम्रो कसरी एटो अन्य नागरिकको भूमिका निर्वाह गर्न सक्छ। गणितको यसमा भन्नु मूँका हुन सक्छ। यी केही महत्त्वपूर्ण प्रश्न हुन्छ जसमा हाम्रो विचार गर्न पर्दछ।

• संख्यात्मक

संख्यात्मक भन्नुहो, गणित हाम्रो जीवनको हरैक पक्षसंग गाणिएको छ राख्ने हाम्रो जनुस्तुक पैसा गर्न। गणित एटो सोचने शैक्षिक हो, तर्क गर्न मध्यम हो, सकारात्मकर र रचनात्मक साथै सक्षम रूपमा विचार गर्न आधार पनि हो। यसमा प्रल्यका राज्यको रूपमा हाम्रो जीवनशैलीमा प्रभाव पर्ने हुन्छ। हाम्रो हरैक जितिकालापमा गणितीय धारणाहरू प्रस्तुत
पाइनेन्ट जसका माध्यमवाट वालवालिकाहरुलाई प्रभावकारी ढंगमा गणित सिकाउन मुद्दत पुनष्ट छ। यसोंमा हाम्रो वालवालिका गणित विषयमा अवश्य राम्रो गर्ने छ र हाम्रो सहयोग उनीहरुप्रति निरन्तर रहिरहने छै।
ANNEX VI: Demography, Activities and Outcomes of Piloting

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Day One (July 8, 2007)

Orientation

The purpose of the orientation program was to inform parents, teachers and students about piloting of the curricular materials. The school had invited some parents, teachers and SMC members for orientation.

Krishna Poudel conducted the orientation program formally. Ajit Lama, Chairperson of School Management Committee chaired the session. Then we had the program schedule:

1. Distribution of curricular material: set I for parents.
2. Introduction of the material: by Shashidhar Belbase
3. Opinion on our program: Dammar Bahadur Ghalan.
4. Discussion on curricular material (Set I) with parents, SMC members and teachers: Tikaram Pokhrel
5. Poem Presentation: Amrit Poudel
6. Opinion on the curricular material in the context of mathematics learning: Bir Bahadur Tamang
8. Opinion of SMC Chairperson on the program

Day first activities were conducted as per above order. We built rapport with teachers, parents and SMC members. We shared our materials to them and asked them to read. They read it and put their brief opinion it. The School Management Committee Chairman Ajit Lama and one of the guardians Tok Bahadur Ghalan spoke about the reading material. They mentioned that the reading material about Mathematics around Us is very interesting and useful to know how they can help their children. It is a guide for every parent.

Outcome of the Orientation

The major outcome of the orientation was that we could inform about the piloting of our curricular materials. We also interacted with parents, teachers and SMC members regarding the first set of curricular material that was prepared for parents. The participants were fully supportive to our program. They expressed their expectation that
the curricular materials will be helpful to bring some improvement in school mathematics.

**Orientation on resource materials**

*Day Two: July 12, 2007*

*Theme: Arithmetic in Our Daily Life*

We reached to Ugra Tara School on July 12, 2007 for the start of orientation. Orientation was conducted in the reading room of the school.

*Purpose:* The main purpose of the orientation was to introduce the curricular material on “Arithmetic in our Daily Life” to the teachers and motivate them for contextualizing mathematics teaching through it.

*Orientation Process:* At first we talked to the participants about general overview of the training. Then we entered into the subject matter. The Orientation period of the day had been divided into three sessions.
First Session: The main intention of this session was to share experiences of teaching mathematics in schools. So we asked the participants in the Orientation to express their views, opinion and experiences of teaching in school starting from their introduction.

- At first there was introduction session. The team members of Orientation and teachers who were participants in the Orientation introduced with each other.
- Experience of being mathematics teacher was shared by each participant.
- They shared their opinion about teaching mathematics in school.
- They shared their opinion about curriculum and textbooks.
- They shared their experience of applying mathematics out of school.
- They shared their expectations of the training.

After introduction we formed four groups of participants in order to share their experiences in their group at first and then make a note of important points. After discussion and sharing in each group they shared their ideas.

**Group I** consisted of Durga Lama and Bir Bahadur Tamang and they expressed their view in the following ways:

- We are feeling good to get opportunity to teach mathematics.
- We are feeling difficulty in teaching mathematics due to lack of trainings.
- Our teaching method was teacher centered.
- We write on the board and students copy.
- There is lack of teaching materials and other references.
- Students are feeling difficulty due to language.
- There is no cooperation of parents to do students' activities.
- The answer key given at the end of the textbook has created problems.

**Group II** consisted of Suresh Man Thing, Raghu Shrestha, Tej Man Thing and they expressed their views in the following ways:

- They feel good when they teach mathematics practically.
- They opined that mathematics raises awareness about daily life problems.
- They feel that they have to take care of children of all categories.
- Students are not regular in the class.
- There is not any teaching material in the school.
- Parents do not help students to get the materials they need.
- Language is a problem.

**Group III** consisted of Basant Tamang, Sanu Bhai Ahikari, Nanu Thapa. The views, opinions and experiences this group was as follows:

- They feel good when their students understand what they teach.
- They feel good when they can link mathematics with some local context.
- They feel good when their students get promotion to upper grades with satisfactory results.
• They feel unsatisfied when they can not make students understand the basic concepts of mathematics.
• They are not satisfied as the students do not perform well during final examination.

**Group IV** consisting of Tara Shrestha, Anju Lama opined that:

• They think that they have to use other local resources except textbooks in teaching mathematics.
• They think that it is better to make teaching materials from locally available materials.
• They opined that it is better to teach mathematics making it more practical and applicable in daily life.
• They are not satisfied from traditional method of teaching mathematics.
• They also opined that it is not good to teach using lectures and teacher centered methods.

After sharing of experiences we moved to the next session with a short tea-break.

**Session Two**: The purpose of this session was to share the reading materials on “Arithmetic in Our Daily Life” among the teachers, orient them and motivate them for contextualizing of teaching arithmetic in the classroom. So the discussion on Teachers’ and Students’ Reading Materials was held with the following activities:

• All the teachers were requested to read the materials once. One of the teachers read it loudly and others went through line by line with the reader.
• Then teachers highlighted the things which were not clear to them.
• There was discussion on the unclear matters among teachers and trainers.
• The teachers put their opinions.

**Outcome of the Session**

• All the teachers accepted that the reading material opened their eyes regarding the way they teach and the students miss the opportunity to participate in activities.
• More discussion was held in lesson plan and project work.
• All of them opined that they can follow the lesson plan but project may be a bit difficult.
• They suggested for some corrections in the language part.
• They opined that the students’ reading material was fine except some language corrections needed.
• They expressed their view that they had not been much careful about local examples of arithmetical operations. Now they are excited to bring various local examples in the classroom to teach arithmetic portion.
• They expressed that such practice should be started from primary level. The teachers who were teaching in primary level in the three schools were more
excited and promised to use local context for teaching mathematics in the classroom.

Concluding Remark

The first day of the Orientation was very exciting. The participants were fully enthusiastic to read the material and put their views about the material. They were fully convinced that reading material opened their eyes. Their traditional view of mathematics as difficult subject has been challenged for the first time. We all the trainers were very much excited to get very good comments from the teachers as feedback for us. The program ended with brief concluding remarks by one of the participants. She told us that she had been highly motivated to teach arithmetic in an interesting way exploring various local examples.

Day Three: July 13, 2007

Class Observation

The main purpose of the class observation was to see to what extents teachers are motivated to apply contextualization of mathematics teaching after Orientation 1. Two observers observed a class in Ugra Tara Lower Secondary School in order to see whether teacher applied contextualization of mathematics teaching with local practices or not.

Class observation was based on the following criteria with scale 1 (Needs improvement), 2 (Satisfactory) and 3 (Very good).

Teacher’s Name: Raghu Nath Shrestha

Period 2

Grade VI

Topic: Addition of Arithmetic Fraction

1. Beginning of lesson 1 2 3
2. Environment before entering into subject matter 1 2 3
3. Entering into subject matter 1 2 3
4. Introduction of subject matter 1 2 3
5. Examples used 1 2 3
6. Search of examples 1 2 3
7. Role of teacher and students 1 2 3
8. Internal evaluation 1 2 3
9. Utility and context of the examples with subject matter 1 2 3
10. Final evaluation 1 2 3
The teacher had a brief lesson plan. He started addition of fraction with a question to the class: If an orange is divided into two equal parts, then what one part called and how do you write it mathematically? When you two halves, what is the result? In this way the teachers started from questioning. It was very nice to start from a context and question. The environment in the classroom was very nice as all students were curious to participate in activities. However when the teacher entered into the subject matter, he turned the textbook and started with definition of fraction. The examples used were good and he engaged them to search more examples. The role of teacher and students was not much clear as he did his part frequently without much caring to the students and their participation. He evaluated students’ performance through questions and group works. He concluded his lesson with a simple example of addition of like fractions. He assigned five questions to do at home. This shows that the teacher was coming to right track of teaching mathematics but still there were things to improve in the area of student participation and evaluation.

Day Four: July 14, 2007

Theme: Set around Us

The purpose of this day’s Orientation was to introduce the curricular material on “Set around Us” and motivate teachers to teach the concept of set in a student friendly manner connecting the ideas of set with daily life situations. The whole Orientation period of the day was divided into three major sessions.

Session one

The objective of this session was to introduce the concept of set with a brief activity of a game. So, all the participants were taken to the school play ground. They were asked to be in three groups according to their preference to the drink: tea, milk or yoghurt. They stood in three groups according to their preferences. Some of them opined that they prefer more than one drink. This created a bit confusion among the participants regarding where to stand. One of the trainers immediately drew a Venn-diagram on the ground with a stick and asked them to stay in different rooms according their preferences. They did it perfectly. Then trainer asked them to raise hands if they belonged to the groups called:

a. Who preferred tea only
b. Who preferred milk only
c. Who preferred yoghurt only
d. Who preferred tea and milk
e. Who preferred milk and yoghurt
f. Who preferred tea and yoghurt
g. Who preferred all the three drinks
h. Who preferred neither of these drinks
After 20 minutes play, all the participants returned to the Orientation room. Then they were divided into three groups to discuss about the game they played and its connection in teaching set in the classroom.

All the three groups discussed themselves and then came up with following ideas about the game:

*Group I* consisted of Tej Man Thing, Raghu Shrestha, Sureshman Malla, and Sanubabu Adhikari expressed their view that from such games we can give concepts of sets, members of sets, forming different sets from game. They opined that games can be useful the teach numbers, odd and even, square and square roots and many more.

*Group II* consisted of Taradevi Shrestha, Durga Tamang, and Bir Bahadur Tamang expressed that they could give concept of sets, concepts of numbers, concepts of different kinds of sets and elements, union of sets, intersection of sets, difference of sets and many more. Students learn and enjoy the game during learning.

Group III with members Anju Lama, Nanu Thapa, Bhim Bahadur Ghalan, and Basant Tamang expressed their views this way: We can define sets, form different kinds of sets, different way of forming different sets, concept of union-intersection-difference and concept of number system. Students can learn from the games with much joyful way.

We as trainers summarized the session stating that games can be applied to materialize the concept of sets in different forms and contexts.

*Activity Two*

The main purpose of this session was to introduce the reading materials for teachers and students on “Set around Us”. So the reading materials for teachers and students were distributed. They were asked to read and note the points they could not get well. After completing reading individually, they were asked to discuss in groups. Three groups were formed as above and they had to write some good points about the material and some weaknesses they find in it. Then there was reflection of each group.

*Group I* with members Tej Man Thing, Raghu Shrestha, Sureshman Malla, and Sanubabu Adhikari expressed their views as: We liked the material very much. We came to know that students can explore different examples of sets from their own home and community. They can bring different kinds of sets from their experiences.

Group II consisted of Taradevi Shrestha, Durga Tamang, and Bir Bahadur Tamang expressed their views as following: We liked the poem very much. The examples are very nice and we find many more examples from our daily life and students can easily grasp it if we link concept of sets with our daily life.

Group III consisted of members Anju Lama, Nanu Thapa, Bhim Bahadur Ghalan, and Basant Tamang. They expressed their views that the language is clear. We came to know
that set is everywhere. We are dealing with sets all the time though we do not use the word set. Set is everywhere from school to home. We learnt that students can explore lots of ideas from their life if we encourage them to find such ideas. The weakness in the material is that some where there are grammatical mistakes.

Session Three: Reflection and Concluding

The purpose of this session was to collect concluding reflection of one or two participants. One of the participants was requested to summarize from activity two. She expressed her view that reading material is very exciting. It is very useful for them to know about usefulness of local examples in teaching mathematics. Next participant opined that reading material on “Set around Us” is very helpful for them to link daily life practices with mathematics in the classroom. He further stated that this kind of material is helpful to know how students can be involved different activities out of the textbooks. He mentioned that students’ reading material is very useful for the students to search sets from their daily life and it helps teachers to convince students to bring various local examples from their home and community.

Then the trainer summarized the ideas in the reading material and requested the teachers to focus on the use of local materials and context in teaching and learning of mathematics in the classroom.

Day Five: July 15, 2007

Class Observation

Purpose: The main purpose of the day’s activity was to assess how teachers apply the things they learnt from Orientation and curricular materials into classroom situation.

Following picture shows that a teacher is engaging students in activities and demonstrating what students did in the classroom. Students worked on sets of different objects from their daily life.
Class observation was based on the following criteria with scale 1 (Needs improvement), 2 (Satisfactory) and 3 (Very good).

Teacher’s Name: Raghu Nath Shrestha

Period 2

Grade VI

Topic: Set

1. Beginning of lesson 1 2 3
2. Environment before entering into subject matter 1 2 3
3. Entering into subject matter 1 2 3
4. Introduction of subject matter 1 2 3
5. Examples used 1 2 3
6. Search of examples 1 2 3
7. Role of teacher and students 1 2 3
8. Internal evaluation 1 2 3
9. Utility and context of the examples with subject matter 1 2 3
10. Final evaluation 1 2 3

Result of the Class Observation: The teacher tried to begin the lesson with question: What is set? This question puzzled the students and they could not answer this question except by a few of them. He tried to create environment by motivating them to write five examples of sets from their daily life. Students were confused as they were not much
clear about whether particular action or object is a set or not. When he entered into the subject matter, it was a bit difficult for him to link set from daily life with textbook.

He introduced set with a Venn diagram that was very nice. It would be even better if he had used some concrete materials. Examples searched by students from their daily life and it were very impressive. Students were seem to be enjoying the activities.

In the later part of his lesson, the teacher was confused in his role and students’ roles and responsibilities. He frequently tried to dominate the role of students. His examples from the context were nice but still internal evaluation was not in perfection and needed more practice and training.

*Day Six: July 17, 2007*

*Theme: Grand Tour of Geometry*

*Purpose:* The main purpose of the day’s Orientation was to introduce the curricular material on “Grand Tour of Geometry” to the school teachers and help them understand how local materials can make teaching mathematics interesting and meaningful.

The Orientation period of the day was divided into three sessions. The first session was about exploring geometry from the school compound, the second session was introducing the ideas of paper cutting in geometry teaching and the third session was focused on the introduction of the reading material “Grand Tour of Geometry”.

In each session the participants worked in individual and then in group and shared their ideas with the group members and then made presentation from each group.
The trainer is introducing the idea of geometry from local context. He is emphasizing on the search of local examples for teaching geometry in an effective way.

In the above picture, participants are developing the concept of how to contextualize teaching geometry in the classroom.

Session One

As already mentioned, the purpose of this session was to search of geometry from the school compound. So, all the participants were taken out of the Orientation room to the school ground and they were asked to find out five objects that were useful to teach some geometrical concepts in the classroom. All the participants went out to the school ground for ten minutes and they observed different objects and made a short note with brief sketches. They were requested to be back after ten minutes.

All the participants came with their ideas of different objects to teach different geometrical concepts. They were then requested to discuss in groups forming three groups. After group discussion each group made their presentation.

Group I: Rectangle in the window pan, straight and curve lines in the branches of trees, the way to school, the upper part of drinking glass is a circle, angles in the branches of trees, right angles at the corners of bathroom, the rods in the window are parallel.

Group II: Straight line in the slide, bending bamboo is a curve, face of a brick is rectangle, angles at the joint of branches of a tree, the water pipe is straight, and the mountain looks triangular, school’s floor, walls and roof form pentagonal structure.

Group III: Blackboard of school is rectangle, side of the roof of school is a triangular, the school compound is rectangular, right angles are the steps in school to the classrooms,
one side of roof is rectangular, the national flag has triangular shape, the top of mane is triangular, and the rods in the window are parallel.

When all the groups finished their presentation, the trainer recited a poem he created within ten minutes when the participants were searching geometry around the school.

Session Two

The purpose of this session was to help teachers contextualize teaching geometry using paper cutting. They were provided with sheet of paper, scissors, and scales. The participants were asked to make a tangram and dismiss the seven pieces and rearrange them to form square, rectangle, triangle, parallelogram, trapezium and other different figures like boat, ship, rocket, bird and animals.

Participants are practicing paper cutting to form different geometrical patterns. Tangram was very exciting activity. They made it, arranged it in different form and enjoyed the properties of tangram.
Outcome of the session: The trainees demonstrated that how geometry teaching can be done effectively by the use of paper cutting. The participants opined that they had realized the importance of such low cost and no cost materials in the teaching of geometry. They had thought that geometry teaching requires expensive materials but this activity changed their view that geometry teaching can be done effectively using paper cutting which does not cost much to them or school.

Session Three

The main purpose of this session was to introduce the curricular material “Grand Tour of Geometry” among the teachers and motivate them to contextualize teaching of geometry by using locally available materials and artifacts.

The reading materials for teachers and students were distributed to all the participants. They were requested to read the materials individually. When they finished reading they were asked to talk in pair about the materials (contents, language and utility).

Geometry in Plough: Teachers were very curious to discuss about geometry in a plough. They came to express the idea that application of angle is clearly visible in the plough. They mentioned that if oxen are large enough the angle in the plough is increased, when the oxen are not so big then the angle of the plough is made smaller. Similarly the angle of plough is made smaller or bigger according to the quality of the land too.

The participants discussed about the slope of roofs in the houses of cold and warm region. The participants were excited to know that students can be engaged in project to explore geometry around their home.
There was a little bit more discussion about student project works on geometry. The participants wanted to send their students for such projects to explore geometry from around their home.

In the above picture, the trainer is demonstrating how projects can be designed for students. The participants were asked to discuss on the steps of students’ project and the trainer noted their main points on the board. Later he explained each stage of the project work with example.
Concluding Remarks: There was discussion on the students’ reading material too. All the teachers liked the materials. They expressed that the reading materials were excellent. However they suggested us to keep some games in the material with clear ideas of how to play, what are the rules to follow and a geometrical sketch for the space to play.

Suresh Man Malla spoke as a participant reflecting his views from the activities above. He mentioned that we need not go far away to search teaching materials. They are around us in different forms. It does not cost any money to find them to use them in the classroom teaching. It was really exciting remarks from the side of participants.

Day Seven July 18, 2007

Class Observation

The main purpose of this activity was to observe how the teachers are applying contextualization of mathematics in their classroom teaching after participating in the piloting Orientation and orienting about the curricular material on “Grand Tour of Geometry”. We observed a class of grade six in Ugra Tara Lower Secondary School, used the following simple tool to note down the general practice that we could observe in the class.
Class Observation

Class observation was based on the following criteria with scale 1 (Needs improvement), 2 (Satisfactory) and 3 (Very good).

Teacher’s Name: Bir Bahadur Tamang

Period 2

Grade VI

Topic: Types of Angles

1. Beginning of lesson 1 2 3
2. Environment before entering into subject matter 1 2 3
3. Entering into subject matter 1 2 3
4. Introduction of subject matter 1 2 3
5. Examples used 1 2 3
6. Search of examples 1 2 3
7. Role of teacher and students 1 2 3
8. Internal evaluation 1 2 3
9. Utility and context of the examples with subject matter 1 2 3
10. Final evaluation 1 2 3

Concluding Remark

Bir Bahadur Tamang entered into the classroom with some teaching materials in his hands. We followed him into the class. He started with demonstration of a pair of sticks keeping them parallel, perpendicular, at an acute angle, and obtuse angle. It was very nice activity. He created very encouraging environment to bridge the idea of angle with types of angles. He then kept third stick over the two parallel sticks and asked the questions about adjacent and non-adjacent angles.

He then pointed to the roof of the classroom and asked students to point where they could see adjacent and non-adjacent angles. Later he introduced the concept of alternate angles, corresponding angles, vertically opposite angles and co-interior angles. Students were found to be engaged in the naming the angles they could see in the roof top.

He asked students to generate a few examples of vertically opposite angles, corresponding angles and alternate angles from their daily life. Students were trying to find examples from their home, swing and support made of bamboo for squash farming.

However the teacher could not assess the achievement of the students timely and systematically in the class. He asked students in group and most of them raised their
hands but a few of them could not respond his questions and he could not further start activity for remedial.

Day Eight July 22, 2007

Theme: Measurement in Our Daily Life

Purpose: The main purpose of day eight was to introduce the concept of measurement in our daily life with the help of curricular material. The secondary purpose was to help teachers to contextualize teaching mathematics using local materials and examples.

The Orientation session was divided into four sessions. The activities in those four sessions have been discussed in the following section.

Session One

The purpose of the first session was to explore the ideas of measurement at local level from the participants. So, all the participants were asked to think of different measurements in their daily life. Then they were asked to discuss in group about the measurement systems in daily life. Each group listed measurements of length, weight, time, volume, currency (price), temperature, and number. They listed the local measurement together with standard measurement of metric system. Each group made a nice presentation explaining the way they have realized different measurements in daily life. This activity was really very helpful to bring their ideas into discussion in relation to the curricular material.
**Session Two**

This session has the purpose to introduce the concept of measurement with the help of reading materials prepared for teachers and students. So, the reading materials of *Measurement in Our Daily Life* were distributed to all the participants. They were requested to read individually at first and then pair sharing. They were asked to note down the points that they could not understand or were not much clear to them. Also they were requested to write some weakness in the materials.

After discussion in pairs, all of them mentioned that the contents do not cover all aspects of measurement. They opined that the textbook does not contain these systems and we have to explore them ourselves that may be sometimes difficult to convince students why our system is not same as standard system.

This session encouraged them to make teaching measurement more contextual and student centered. Finally one of the participant opined that the reading material with dialogue and poems was very effective and students reading material was also nice in terms of introducing the concept from local practices.

**Session Three**

The purpose of this session was to help the participants prepare lesson plans to teach measurement in their classroom. So, they were divided into three groups. Necessary materials were distributed to each group. The participants were requested to prepare a lesson plan in three groups to teach measurement of volume, length and weight respectively to teach in grade six or seven.

Group I: This group prepared a lesson plan on volume. They mentioned the objective of the lesson as to enable students to select appropriate scale for the measurement of volume. They tried to connect the concept of measurement of volume at local level using mana, pathi with the standard measurements such as liters. They prepared a chart and explained how students can engaged in search of different measurement of volume.

Group II: This group prepared a lesson plan on measurement of length. They prepared it listing the local system and standard system side by side. The way they demonstrated the plan, it was a nice example of how to connect local practice with textbook and curriculum practice.

Group III: The third group worked on the measurement of weight. They also started from listing the local methods of measuring weight in terms of sher, dharni etc and linked them with the standard measurement of Kilogram. They demonstrated how to bring such local examples from daily to life to classroom.

This session (session III) helped them to prepare a brief lesson plan to teach measurement in the classroom using local examples and materials.
Session Four

As some of the participants were requesting us to make the project work a bit more clear, we extended the Orientation session by 30 minutes to discuss on student projects. So the purpose of this session was to help the participants to be able to design student project in mathematics. So, we started with brief discussion about the project works that can be useful for students to do themselves under the guidance of the teacher. The project work in the material seemed more formal. So, the participants were a bit confused with many steps explanations. But the trainers made it clear that all the steps are not necessary for students. These steps are just for teachers to understand the project clearly. They were convinced that students can be engaged in simple activities like: discover five different measurements from your daily life, explain how/why they are useful for us.

The trainer is helping participants to understand students’ project design.

Concluding Remark

The four sessions made the program longer than usual but the participants were participating in all activities with great enthusiasm. So it was very encouraging situation for us to interact with them. Session one and their reflection showed that teachers were aware of the local systems of measurement but they opined that they rarely used them in
classroom teaching. The second session was more important for us as it was directly related to the curricular material. Their response during the interaction showed that they were highly motivated to apply local context in mathematics teaching. The third session about lesson plan was also very practical as they prepared lesson plans but is brief (due to time factor we could not prolong this part). The fourth session regarding students’ math project helped them to plan for such projects in brief. Their confusion about long process of project work had been removed by encouraging them to start from very simple projects such as exploring different system of measuring lengths in local context, their application and connection with standard measurement.

In this way the session ended with the brief review of each session of the day.

*Day Nine* July 23, 2007

**Class Observation**

The main purpose of this activity was to see how teachers apply the concept of contextualization of teaching measurement in grade six. We observed the class of Bir Bahadur Tamang using the following tool.

**Class Observation**

Class observation was based on the following criteria with scale 1 (Needs improvement), 2 (Satisfactory) and 3 (Very good).

Teacher’s Name: Raghu Nath Shrestha

Period 2

Grade XI

Topic: Measurement of Length

1. Beginning of lesson 1 2 3
2. Environment before entering into subject matter 1 2 3
3. Entering into subject matter 1 2 3
4. Introduction of subject matter 1 2 3
5. Examples used 1 2 3
6. Search of examples 1 2 3
7. Role of teacher and students 1 2 3
8. Internal evaluation 1 2 3

**Concluding Remark**

We entered into the classroom with Bir Bahadur and took the back seat with students. Bir Bahadur started his lesson with questions: How do we measure amount of water at our
home? How do we measure amount of milk? How do measure potato, squash and millet? How do we measure length of a rope? He asked students talk in group for a while. Then he asked them what they had thought about the questions. He noted their points on the board. It was a nice beginning. He continued asking and noting them on the board. After a while started with a topic: measurement of length. There were many in the list and he chose length. He tried to connect the idea with local measurement of length but he felt a bit difficulty in relating them with standard measurements of length. Kosh was confusing to them.

He continued with addition and subtraction of measurements from textbook. He could do it without textbook at first. But now he deviated from local examples. Though he engaged students in problem solving, but he could not create a bridge in between local and standard practices of measurement. Students in group could solve three problems from book regarding addition and subtraction of lengths.

Finally the bell rang and he could not do evaluation part systematically. It was lacking in all most every class. So, we thought to discuss about this issue after the class. As a whole it showed that his class was successful to contextualize the concept of measurement through examples.

Day Ten: July 29, 2007

Theme: Algebra in our Daily Life

(This materials could not be finalised and included in the final set of materials)

Main purpose of this part of the Orientation was to introduce the concept of algebra through the curricular material helping teachers to understand that algebraic thinking as one of the important aspect of mathematics teaching and learning. The secondary purpose was to help participants in the contextualization of teaching algebra at lower secondary level.

The Orientation period had been divided into three sessions so that we could focus on the specific issues effectively.

Session One

The purpose of this session was to help participants develop algebraic thinking from local practices. It was help them generate examples of algebraic structures or expressions from their own experiences of daily life. They had to work individually at first and then in groups.

All the participants were requested to find five- five algebraic expressions from within the school compound. They were asked to share in three groups. The group members discussed their ideas with other members and finalized their list.
Group I consisting of Tara Shrestha, Bir Bahadur Tamang, Durga Tamang and Dammar Ghalan formed different algebraic structures as following: Area of blackboard = xy, at the ceiling there was cross section of two perpendicular beams and each angle was x, then find the value of x, number of male teachers in the Orientation m and number of female teachers n and total number m+n, number of tables in a class p and number benches q and total to be p+q, there are a number of pages in a book and total number of such books in the library is b, total number of pages now is ab.

Group II consisting of Anju Lama, Sanu Bhai Adhikary, and Sanu Thapa brought their ideas as following: The length of a rod in the window is x and ten such rods in the window being 10x, Total number of participant in this Orientation is x and number of female is y then total number of males is x – y, length-breadth-height of a room is a, b and c respectively and volume being abc, length and width of roof of room are p and q making area of the roof pq.

Group III consisting of Basant Tamang, Tej Man Thing, Raghu Shrestha and Sures Man Malla worked out this way: Number of boys and girls in a class to be x and y then their sum being x + y, number of benches being x and each bench carries four children, then total number of children being 4x, number of pens in a bag is x and number of such bags in the office is 10 so the total number of pencils in all bags being 10x.

Outcomes: The group members made presentation on each idea they listed. They generated these examples from the local context. “Before this activity, I had thought that algebra is mathematics of letters. But now I realize that algebra is mathematics of objects and our practices that we represent using letters (Raghu Shrestha)”. This reflection of Raghu clarifies that the out come of the session I was really great. That had changed the mind set of teachers about algebra.

Session II

The purpose of this session was to help participants understand the concept of variables and constants from local context. Actually it was to help them explore the idea of constants and variables in algebra from their own experiences so that they can help their students do the same in the classroom.

The individual Participants were asked to collect examples of constant and variables from the local context that can be used in classroom teaching. They worked individually for about 15 minutes to search variables and constants from their daily life situations.

The participants collected examples of variables as: price of squash, amount of milk that a buffalo gives each day, temperature of a day from morning to evening …etc.

They collected examples of constants such as: the length of a rope suspended between two poles to dry clothes, number students in grade six this year in Ugra Tara School, the number of pages in Mathematics textbook of grade six ….etc.
There was discussion on how students can be engaged in the search of more local examples of constants and variables.

*Outcome:* This session provided opportunity to each individual in exploring the idea of constants and variables from their day-to-day life. They opined that they can do the same in their classroom. This change in attitude (mentally) was also a good outcome.

**Session III: Calendar Game**

The purpose of this session was to help participants understand how algebraic concepts can be developed with games and play. For this the trainer fixed a calendar at the side of the board. Then participants were asked to choose four numbers from the calendar that are close to each other and form a square shape. The teachers were asked to add those numbers and tell the sum. When they told the sum: the trainer told the four numbers they had selected. For a while all the teachers were surprised. Later they were asked to find the key with algebra.

*Outcome:* This game made them very excited about the use of algebra in the games.

**Session IV**

The purpose of this session was to introduce the concept of algebra and algebraic thinking through the reading material that we had developed. The participants had to read the material individually, then share in group and finally present their views. So, all the participants were asked to read the given reading materials. They were asked to read the materials individually at first and then share in group.

When they finished reading individually and then group sharing, they noted down important points regarding the curricular material. They made a presentation by each group.

The members of group I opined that the idea of local practices in algebra is encouraging. They mentioned that they had not thought about algebra that way (as discussed in the curricular material). Now they realized that algebra is everywhere with other mathematics.

Group II expressed that the examples of algebraic expression from daily life, constants and variables and formation of algebraic structures using paper cutting was very exciting. “We never learnt what was $a + b$ whole square in actual sense but now we got it (Dammar Bahadur Ghalan)”.

**Concluding Remark**

From the excitement of the teachers it was clear that they had new insights about the concept of algebra. The way they interacted was very much fruitful to them to understand the nature of algebra (and other mathematics too). They could generate many examples of
algebraic expression, variables and constants from their daily life. I think it was a remarkable achievement to them from the orientation and curricular materials.

Day Eleven: July 30, 2007

Class Observation

The purpose of this activity was to see to what extent teachers were able to transfer the skills they learnt from the orientation and curricular materials into the classroom teaching.

The classroom observation was based on the immediate practice of the teacher in the classroom just after next day of the training. So, it was difficult for us to see whether there was change or not and whether it was due to the orientation or curricular material.

Class observation was based on the following criteria with scale 1 (Needs improvement), 2 (Satisfactory) and 3 (Very good).

Teacher’s Name: Bir Bahadur Tamang

Period 2 Grade XI

Topic: Algebraic Expression

1. Beginning of lesson 1 2 3
2. Environment before entering into subject matter 1 2 3
3. Entering into subject matter 1 2 3
4. Introduction of subject matter 1 2 3
5. Examples used 1 2 3
6. Search of examples 1 2 3
7. Role of teacher and students 1 2 3
8. Internal evaluation 1 2 3
9. Utility and context of the examples with subject matter 1 2 3
10. Final evaluation 1 2 3

Concluding Remarks

The purpose of the class observation was to see the effects of orientation and curricular materials in the classroom teaching. So, we had a simple tool to note general impression in the class and noted other things in our diary. That helped us to discuss on the process part in the delivery of the lesson.

We entered the classroom with the teacher. He had some sticks in his hand (last time he had used same sticks in geometry). After greeting the class, he told them to take their
seats. Then he observed all of them from front to the back. He showed them sticks and told them to guess why he brought sticks.

Students buzzed for a while. Some of them guessed that they were to beat them. Some others guessed that he is going to teach geometry by using them (as he had done so in the earlier class).

He asked them how long the table at the front was. How long the room was? The students guessed the lengths of the table and room in their own way. He then asked one student from the first bench to come to the front and asked her to measure the length of the table with one of the sticks he had. She did the same and it was twice the stick. How to write it mathematically? He asked them. No one could answer. He then told them that if the length of the stick was $x$ what would be the length the table? Two/three students from the middle benchers replied that it would be $2x$. He thanked them. I motivated them. This way he asked some more questions related to length and area using algebraic concepts. Students participated nicely. It was really a very good class.

He encouraged students to generate different examples of algebraic expressions of simple type; he was assessing their performance by questioning and listing their findings from their groups. He could not judge how many of them really understood and how many of them could not understand at the same time in the class.

*Day Twelve: August 3, 2007*

*Group Discussion*

*Purpose:* The main purpose of group discussion was to assess the curricular materials from the viewpoint of teachers, parents and SMC members and students. The assessment was based on the group discussion with them. A simple guideline had been prepared to lead the group discussion. The group discussion had been recorded and transcribed to schematize the major ideas.

This was a final day of the piloting of the curricular materials. We had invited parents, SMC members, teachers and students for group discussion about the materials in different groups. We had focused our discussion in the teachers’ reading materials, students’ reading materials and parents’ reading materials. There were three different groups: teachers, students and parents with SMC members.
ANNEX VII: Outcomes of the Group Discussion with Teachers

Positive aspects of the curriculum support materials:

- Idea of use of local materials in teaching mathematics
- Child centered teaching and learning to be applied in the classroom.
- Games, poems, stories for teaching mathematics is very effective.
- The concept building about mathematics as an interesting subject and it is not as difficult as people think of it.

- The Orientation has changed our thinking that mathematics is a difficult subject. Actually it can be taught very interesting way by using local materials.
- The materials are simple and arranged in order.
- This Orientation opened our eyes. We realized that textbook is only a reference to teach but real things that we can use are in our own daily life.
- This Orientation was very effective for motivating students by using local materials. The reading materials are very useful for us to know about how mathematics can be taught in an interesting way from local examples.

Similarly we summarized the weaknesses of the curricular materials as following:

Weak aspects of the materials:

- There should be more discussion on contents related to textbooks
- There is much emphasis on contents of grade six and seven but emphasis should be given on primary level too.
- The orientation period is very short (12 days is not sufficient)
- The orientation should be designed to cover all aspects of school mathematics. This Orientation covered only limited area in Arithmetic, Geometry and Algebra.

Following our simple guideline of group discussion, we asked the participants questions and presented are their collective views:

What is the current practice of teaching and learning mathematics at present?

The participants in the group discussion opined that:

- Teaching mathematics at present is fully dependent on textbook.
- It is teacher centered.
- Teachers speak all the time and students are only passive listeners.
- Teachers think that there is lack of teaching materials.
• Every activity in the classroom was dependent on textbook.
• Teachers think that every thing should be done by teachers and students have to copy them.
• There is no sharing of ideas with students.
• We follow the way our teachers use to teach.
• We tell our students rote learn mathematics that is wrong.
• We never go out of textbook.

Did you find any difference in students’ motivation after this training?

• Yes, we found that students are highly motivated when they are taught by using local examples and contexts.
• The group work has highly motivated them to learn from each other that was not in our practice before this training.
• Students have now started speak up about what they know already from daily life.
• They have realized that mathematics can be learnt with games and plays.
• We came to know that only textbook is not sufficient to teach mathematics rather we can do many more from our own practices. Just we need to view them mathematically.
• This new approach has made them more enthusiastic, responsible and creative towards learning mathematics.
• The projects have helped our students to develop their leadership role in the classroom.

What sort of activities did the students prefer in the classroom?

• Observation of mathematical activities and objects.
• Doing project works in groups
• The flexibility in group work to ask each other when they don’t know made them more active.
• They were interested in games, poems, stories and dialogues

Participants Feedback on Each Material

We had their feedback to each participant regarding individual materials from II to VI. They individual views had been collected and then mentioned below in collective form. Repeated views have been mentioned only once.

Journey with Measurement

• The reading material is very useful and it is practical.
• This has made teaching measurement and unitary method easy to us.
• This material has occupied about 60% of the content of the textbook for conceptual thinking.
• There is originality and it has made us that these contexts are all ours and as if we are there in every part of the material.
• There is everything fine in the reading material except some typing mistakes.

_Grand Tour of Geometry_

• This reading material is very interesting. The pictures are very nice.
• This covers about 70% of the contents from grade six.
• This has emphasized that we should not fully dependent on textbooks rather it can be just a reference and we can teach a lot of ideas from our own experiences and students day-to-day life.
• The project work was really very nice. We applied in our class and students did very nice with their active participation.
• As a whole this reading material is very nice for us to learn new ideas from own practices.

_Arithmetic in our Daily Life_

• This material is also nice.
• We learnt from this that we can teach arithmetic by exploring examples from students’ daily life.
• The dialogues, poems are very interesting.
• This covers about 50% of the content of grade six.

_Set around Us_

• This reading material is very nice.
• We enjoyed reading it and our students liked the activities very much.
• They were motivated to do group work.
• Project work for collection of different kinds of sets from daily life is very nice. Our students did it with much interest.

_Algebra around Us_

• This reading material is very helpful to understand algebra in daily life.
• We thought that algebra is not practical mathematics but the reading material has changed our that thinking.
• The concept of variable and constants and algebraic expressions are not only letters and numbers but they are real in our daily life. We learnt that algebra is related to our own practices at home, farm, market and other places.
• This part covers about 60-70% of the content of grade six.
Which part of reading material do you find more useful and effective than others?

- Set and geometry.
- The names of students in the dialogue made students more enthusiastic.

Have thought that you will continue practice of teaching mathematics in this new approach by using local context in the classroom?

- Yes, of course.
- I will tell my other colleagues to follow the same way (Bir Bahadur Tamang).
- We will try ourselves to follow the same way in other areas too.

Did you find any difficulty while teaching in the classroom using the way mentioned in the materials (contextualizing with local practices)?

- It was new experience to us.
- It was first time that we used local materials in mathematics classroom.
- Some times there may not be wider participation of all students. Active students are more benefited than those who are relatively passive.
- Students get confused at first due to reason that they have not done such activities before.
- It needs some time to prepare at home before teaching any concept. Only textbook is not sufficient.
- The new method needs lesson plans and without it is difficult to follow it.
- Sometimes it is difficult to link local examples with textbook exercise.

To what extent the lesson plans are useful to you?

- The lesson plans are very nice but it takes longer time. Only 40 minutes period is not sufficient for them.
- The lesson plans are student centered and we have habit of teaching most of the things ourselves. Students get less chance to speak and share ideas. So, the lesson plans are useful to change our own approach of teaching in the classroom.

Did you find any difference between teaching with lesson plan and without lesson plan?

- Yes, there is great difference.
- We found that with lesson plan it is easier to teach.
- Without lesson plan there may not be any sequence of teaching and learning.
- But the difficulty is that we have to teach six periods a day in different classes and so it is not possible to make lesson plans for all of those classes.
- Unit plan can be made for all classes we teach.
Brief plan is possible with objectives and major activities. That will be helpful to conduct classroom activities in a sequence.

How do you find the relevancy of materials?

- It is not possible to have poems, pictures, dialogues in all parts of mathematics teaching but the materials have been designed with our context and that is fine.
- The materials are relevant in our context.
- The pictures in the materials are more relevant in our context as they belong to us. The poems are fine but it would be even better if they are in rhymes (chhanda).
- Other part is fine. They are very much related to our life.

What about lesson plans? Do you think the models are appropriate for you?

- We think that teacher activity should be at left side and student activity at right side but it is opposite in the given model lessons.
- The activities for teachers and students are clear. So, they are appropriate for us.

What is the language of reading materials? How do you feel about it?

- There are some errors in typing.
- The language is suitable for teachers and students of lower secondary too.
- For primary level it should be simpler than this.

Where do you think we have to improve in the material?

- Print mistakes to be corrected.
- Poems to be in rhymes (chhanda).
- The story should be more reality based from daily life of people than old stories.
- Projects are longer. Our students get confusion due to lengthy process. So, it would be better if you make the projects a bit shorter.
- The materials are fully focused in grade six and seven. We want such materials for primary level where it is more necessary too.
- The Orientation period is very short. It would be better if we had longer Orientation period of three months at least.

What demotivates you when you are teaching in a classroom?

- When our efforts are not recognized.
- When guardians think us in a wrong way.
- When children do not do their task, do not take their responsibility.
- When there is frequent absentism of students.
- When students do not get proper care at home.
What kind of cooperation are you getting from head teachers in your schools?

- They co-operate us as per need and context.
- The head teachers are helping us to get some materials too.
- There is moral support to us from the head teachers.

What kinds of co-operation do you get from the community?

- We have not got community support for mathematics teaching as we have expected.
- When we try to call parents’ meeting to discuss about the problems related to their children, they do not come to school in the meeting.
- They only blame us when their children are failed in the examination.
- The parents are not much aware of educating their children. So they are not active in parent teacher meeting.

How is the support from the government?

- It is not satisfactory now.
- The government does not provide us enough materials for study. Only textbooks are not sufficient.
- There is lack of teaching materials.
- There is high ration of students and teachers in school.
- Teachers are not getting enough opportunities for training.
- But things have changed slowly. We are getting better support from government than few years ago.

Is it true that many students fail in mathematics? If so, what is the main cause behind it?

- Yes, we agree that many students fail in mathematics.
- Students and teachers have accepted that it is difficult subject.
- To some extent the language has created problems. Students of primary level whose mother language is other than Nepali feel difficulty in learning mathematics.
- Our teaching method is not also good.
- We emphasize in rote learning. We are not able to help students understand the basic concepts.
- We are heavily depended on textbooks. The teachers are very active in teaching but students are not active learners.
- There lack of use of teaching materials that has made learning mathematics difficult.

How can we improve in teaching and learning of mathematics?

- Developing the attitude that mathematics is easy, interesting and useful subject.
• Teaching mathematics bringing ideas from local contexts.
• It has been very abstract even at primary level. So, students have not realized mathematics in their daily life that has connection with the classroom teaching and learning.
• Teaching of mathematics should be made more interactive, sharing and participative.
• Teaching and learning of mathematics should be based on daily life experiences.
• Teaching of mathematics should be made more interesting the children applying methods of games, plays and other means of fun.

How did you feel about this training?

• The Orientation was very useful for us. It is very much based on our own context.
• We came to know for the first time that mathematics teaching can be done with poems, drama, stories, dialogue and games.
• Mathematics related to our daily practices and it is not as abstract as we used to think.
• The Orientation is an eye-opener to us. The materials and Orientation has changed our thought and certainly it will change our practices too.
• We are feeling as if the blunt knives have been sharpened.
• We expect longer Orientation with these materials to cover other concepts from primary level.

General Impression: The Orientation was very useful for us to know about the materials that we can use in classroom teaching, we can give our students more opportunities to explore mathematics from local context and project are very useful to students.
ANNEX VIII: Outcomes of the Group Discussion with Parents

After introducing to each other we briefed them about our endeavour to develop curricular materials for students, teachers and parents and our objective of doing so. We informed them how we are going to use their views and opinions in the material development and reporting. The following our simple guideline, we conducted the focus group discussion with the following questions and answers:

What is the current practice of teaching mathematics in schools?

- Teachers follow textbooks.
- They teach on the black board and students copy.
- They give home works but do not correct them.
- After reading the paper we came to know that mathematics is attached with every activity in our life. But teachers do not teach that way.
- Teaching mathematics at schools these days is theoretical. It is has no practical value. But after reading the paper we realize that mathematics has a lot of practical value if teachers teach that way.

Do you think children are interested to learn mathematics?

- The thing that has no connection in our life, that is difficult to learn. When mathematics has no connection with our daily life, then it is certainly difficult for our children. When it is difficult, it not interesting for them (School Management Committee Chairman).
- I agree with the chairman (a parent).
- It is fully bookish and teachers do not go out of book (headmaster).
- It is not practical. Our children cannot solve a simple problem at home. What they learn in school is not related to their daily life. So, it is not interesting to them (One of the parents).
- Most of the students take it as a difficult subject. When teachers link it with daily life of students and parents at home, then only it will be interesting for students.

Which part of the reading material did you find more interesting to you?

- Examples of measurements from daily life, geometrical shapes from objects at hour house, the pictures of weaving doko are fine.

How this reading material would be more interesting and useful?

- Wherever you are there is mathematics. When you connect these things with books and classroom then it would be more effective (School Management Committee Chairman).
- It is fine. We liked it (others in the group).
How is the language?

- It is ok (School Management Committee Chairman, agreed by others).

Which part of the reading material needs improvement?

- This fine for the parents who are literate. They can understand mathematics in all activities in our life. It would be better if we think of some materials for illiterate parents too (One of the parents).

In which part of the material you are not satisfied?

- We are satisfied from the material. We are happy because you came to our village, conducted this study, and prepared materials for us, our children and teachers. We hope this effort be helpful to make better materials for our children. We wish that may your wish to develop good materials for children and teachers be successful and may it improve the teaching and learning of mathematics at schools (SMC Chairman).

Do you give some time for your children at home?

- It is difficult for us to take care of our children at home in their study. We are not much educated to help them. We have to depend on school. But now at least we can see what are our children doing and how they are doing in school. (One of the parents).

- When they are small, we can help them but now they are in upper grades and we can not teach them at home. They study themselves (School Management Committee Member).

Do you have any suggestion to us and our project?

- Thank you very much for coming to our village school to conduct this study and Orientation our teachers (SMC Chairman).

- Thank you for your effort to train us and our teachers. May your goals of this study be successful and expand this approach to all schools of Nepal (Head Teacher).

- We are very happy to get you here and share your ideas with us. We will not forget you and your teachings. We are not aware of how our children mathematics (One of the parents).

Concluding Remark

We got very encouraging remarks from parents and School Management Committee members. They were happy to see the material for students, teachers and themselves. They expressed that they had not thought about mathematics so seriously but now after reading the material “Mathematics in Our Daily Life” they
have been encouraged to see the things around mathematically. They told us that they are more aware of how their children learn mathematics. They realized their role to help their children learn mathematics at home.
ANNEX IX: Outcomes of the Group Discussion with Students

Students of grade six and seven were requested to sit in a classroom. One of the teachers helped us to start the group discussion with the students. We asked the students their name and grade they study in. Then we asked them some questions about the reading materials. Their answers were recorded, transcribed and categorized. The major questions and their opinion were as follows:

How many of you liked the reading materials that have been provided to you?

- All most all the students raised their hands and told us that they liked the materials very much. There were no students who did not like the reading materials.

How did you feel about the reading materials?

- They are fine.
- We liked the things from our village.
- We liked our names there in the reading materials.
- We liked the geometry from house
- We liked poems, stories and dialogues.

How is the language in the writing?

- It is alright for us.
• We understand it.
• Only some typing mistakes should be corrected.

Which part of the materials did you like most?
• We liked all the materials.
• We all read them.

Which one of the materials did you like best?
• Geometry around us we like much. Then we liked set around us. Others are also fine.
• All are good as they all talk about our village and people.
• We liked our names in the writing.

Which activity did you enjoy most?
• When our teacher took us to Bajrayogini temple to search about geometry, it was very interesting activity for us.

Do you have any suggestions to us?
• We liked reading materials very much. We have nothing to say further.
ANNEX X: Summary Reflection of the Field Supervisors and Field Researchers during the Piloting

What Could We Do

Now it is necessary to review the process of piloting and see what we could do during the period. Regarding this question it is better to discuss some key points as most of the things are clear from report (as stated already in previous sections).

Changed mind-set of teachers: Practically it is yet to see whether we could change their mind-set regarding nature of mathematics and mathematics teaching but psychologically we were able to convince them that mathematics is everywhere in our day-to-day life and mathematics teaching is not to transmitting knowledge from one mind to another (from teacher to students) but it is making students active in learning process so that they can explore mathematics themselves. It is not a false claim but it their opinion.

Motivated students: Students were highly motivated to read the materials and they have demanded us to develop more such materials. They participated in projects given by teachers and learnt geometry in the temple. They were actively participating in group works when we were observing their class.

Raised awareness of parents: There were not many parents participated during orientation and final discussion about the curricular materials. But those who were in both the meetings and interactions opined that they have realized the importance of their support to children for learning mathematics.

Confirmed the need of contextualized curricular materials: The piloting of the materials has confirmed that students, teachers and parents like such curricular materials and they believe that such materials are helpful for learning mathematics in a meaningful way. The linking of classroom mathematics with day-to-day life not only makes mathematics easier and interesting but it also helps students and teachers to explore their culture and society during study of mathematics.

What we could not do?

We claimed that we could change mind-set of teachers in terms of the pre-existing centred perceptions and practices of teaching to learner-centred teaching, parents and students, confirmed the need of contextualized curricular materials for teachers and students. We had more expectations from this process. We had planned for better outcomes and materials from this piloting process. In this context we would like to state some specific things we had expected but could not do during the process of piloting:

Video graphing: We had planned to make video records of all the Orientation process and classroom observations. We could not do it due to technical problems.
Reflections: We had thought that we would be able to make teachers more reflective about their teaching and learning during Orientation period. We requested them to provide us their reflections by writing a note about their views, opinions and lessons they could learn during the training. They could not do it. We could not force them to do it.

Lesson plans: We had requested all the teachers to prepare lesson plans. But only some of them had submitted their plans. However all of them had made one set of plans during Orientation period.

Closing the Reflection

Piloting of curricular materials has revealed that students, teachers, parents and SMC members (all the stakeholders) are highly positive for the development of contextualized curricular materials. It has been clear that students like such mathematics which has some fun to do and read. Mere textbook is not sufficient for meaningful learning of mathematics.
ANNEX XI: Demography and Outcome of the Validation Seminar

Number of participants in the validation seminar

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<td>School teachers</td>
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<td>University Professors</td>
<td>5</td>
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<td>Field Researchers + KUSOED Team</td>
<td>10</td>
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<td>CDC</td>
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<td><strong>Total</strong></td>
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Comments on Materials

There were comments of different types from the participants of the workshop. Some were about the organization of the curricular materials and some were about the coverage of the contents. Some comments were about the inclusiveness of gender and ethnicity in the curricular materials. Even some comments were on the focus of the materials on local context excessively. Some comments was like that contextaulsiation and inclusive mathematics education was not appropriate in the Nepalese context as we are in the process of globalization. Unsurprisingly, teachers who particiapted in the validation seminar shared positive views about the resource materials while university professors were most critical. In some cases university professors’ comments were beyond the scope and framewprk of this project.

Positive Comments

Participants, especially teachers, appriciated the initiation of contextualization in teaching mathematics through the introduction of such curricular materials which encourage teachers, students and parents in the application of daily life experiences for mathematical understanding and problem solving. Some of the key positive comments were:

- The curricular materials have started a new approach of teaching and learning of mathematics in Nepalese context.
- The curricular materials very simple to read and understand by the teachers, students and parents.
- The curricular materials are in more general form and can be linked to any specific lesson or concept as a model.
- The curricular matearilas are helpful to arise interest in learning mathematics to the school level students
- The sample of curricular materials are good examples of how day-to-day life activities can be source of learning from homes and communities.
- The curricular materials are good examples to show how the mathematics learning and teaching can be made joyful.
The curricular materials have opened the door to write curricular materials in a new way so that students and teachers both will be more creative in learning and teaching of mathematics. The curricular materials have shown how the cultural aspects can be linked with the teaching and learning of mathematics. The curricular materials are successful to introduce constructivist approach of teaching and learning of mathematics which focuses on the active role of students in the learning by constructing ideas as first hand experiences whereas the teacher’s role is demanded as a facilitator only. Any curricular materials have started new beginning in teaching and learning of mathematics schools.

These comments include the major comments of all the five groups’ presentation.

Negative Comments

Some participants, especially university professors, made negative comments in some key concepts of the materials. The negative comments were:

- The curricular materials are simply daily life stories of people.
- The curricular materials are not helpful the learn formal mathematics in the classroom (there is no single example of how it is helpful to learn formal mathematical problem solving).
- The curricular materials are not able to address the issues of gender and ethnicity in the classroom.
- The curricular materials are not focussed on multiculturalism and everything have been woven in the context of Tamang and Gopali community which could be only a reference.
- The curricular materials have tried to reveal that mathematics is not so hard and not so formal but this kind of concept does not help our students pass the exams with good grades.
- The lesson plans are long and teachers have no more time/patience to prepare such plans.
- Students’ projects are vague and does not help teachers to simplify the project works based on major theme as the projects given in the sample materials do not cover specific areas.
- The curricular materials do not seem to empower students rather weaken them as they do not focus on rigorous learning. They only are satisfied with surface knowledge.
- The sample materials do not empower teachers and students rather they are made dependents as the ready made lessons and projects have been suggested.