



The Ethnomathematics of the Kabihug Tribe in Jose Panganiban, Camarines Norte, Philippines

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ABSTRACT

This study qualitatively describes the Indigenous Knowledge Systems and Practices (IKSPs) of the Kabihug tribe in sitio Calibigaho, barangay Osmena, Jose Panganiban Camarines Norte, Philippines, particularly on the observed ethnomathematical practices of the tribe. The phenomenological study approach was employed to illustrate the “lived experiences” of the informants. Through purposive sampling, ten elders and ten schoolchildren from the tribe were selected. Using the ethnographic interview questions adapted from J.P. Spradley’s work and applying participant-observation, they were interviewed and observed during the immersion period. The study was able to describe a glimpse on some of the socio-cultural characteristics of the tribe as well as the ethnomathematical practices that the Kabihug commonly use in their daily lives along: simple counting, ciphering, measuring, classifying, ordering, inferring and modeling patterns arising from the environment. Moreover, the manifested in formal schooling and how they used these concepts and ideas in learning mathematics as taught in the school. Finally, instructional materials in mathematics were developed through the use of the K-12 Curriculum Guide, textbooks and modules for Grades 7 and 8 to highlight and integrate the ethnomathematical practices of the Kabihug tribe. This study offers understanding on Ethnomathematics and contributes to knowledge in the field of Mathematics Education. Likewise, the material as a whole, is intended for the Kabihug themselves, the teachers who are dealing with diverse learners, the curriculum maker, and the school administrators.

Keywords: Ethnomathematics, Culture, Local Practices, Indigenous Knowledge Systems and Practices, Phenomenological Stu.

1. Introduction

Nowadays, many Mathematics classrooms work on the assumption that all students should receive the same mathematical context at the same time and in the same way, "one size fits all" in other words. This is aside from the belief among many Mathematics educators that Mathematics is seemingly free of culture, beliefs and values which unceasingly dominating as part of their pedagogical strategies. This notion holds that Mathematics can be taught in the absence of a common language because it is in fact universal, and this contradicts the current curriculum being implemented by the Department of Education that includes the mother tongue to be the mode of instruction in delivering lessons. Moreover, several teachers do not possess the necessary skills and ideas on how Mathematics can be valued by dealing with the study of Mathematics in different cultures and ethnic groups. This claim was further supported by Favilli and Tintori when the results of their study highlighted the teacher's lack of training courses for teaching Mathematics in multicultural contexts and the need to have some examples of intercultural teaching activities specifically for Mathematics.

Indeed, Mathematics educators are confronting dilemma and issues that are more challenging and that encompasses the diversity of learners. It implies that the socio-cultural background of every individual should be taken into account as part of the learning process. Furthermore, Article XIV of the 1987 Constitution of the Philippines mandates education to: "encourage non-formal, informal, and indigenous learning systems as well as self-learning, independent, and out-of-school youth study programs, particularly those that respond to community needs." DepEd Order No. 62, s. 2011 which is "Adopting the National Indigenous Peoples (IP) Education Policy Framework", likewise emphasizes the country's commitment to achieve its Education for All (EFA) advocacy. This is eminent particularly in the policy statement No. 15, letter c, which is to "provide adequate and culturally-appropriate learning resources and environment to IP learners".

Ubitarian D'Ambrosio, a Brazilian Mathematics educator introduced the coined term ethnomathematics in 1986. It is defined as the study of the local mathematical practices of specific cultural groups in the way of dealing with their environmental problems and every day activities. The prefix 'ethno' refers to identifiable cultural groups and includes their ideologies, languages,

daily practices, and their specific ways of reasoning and inferring. 'Mathema' here means to explain, understand and manage reality specifically by ciphering, counting, measuring, classifying, ordering, inferring and modeling patterns arising in the environment. The suffix 'tics' means art or technique. Thus, ethnomathematics is the study of mathematical techniques used by identifiable cultural groups in understanding, explaining, and managing problems and activities arising in their own environment. Moreover, Ethnomathematics is a research program in the history and philosophy of Mathematics, with pedagogical implications, focusing the arts and techniques of explaining, understanding and coping with different socio-cultural environments. Its purpose is to contribute both to the understanding of culture and the understanding of Mathematics, and mainly to lead to an appreciation of the connections between the two. It is therefore the contention of this study to give ideas on how Mathematics subject can be valued by students and even teachers through understanding the other side of Mathematics, called ethnomathematics. Learning ethnomathematics is learning the applications of some mathematical concepts in real life situations. In order to accept a concept or knowledge as well as its importance, the students must have a connection to it. The result of this study likewise served as one of the bases in preparing instructional materials in teaching Mathematics where this topic is integrated and emphasized to some particular lessons. As Rowlands and Carson (2002) reflected in their critical review of ethnomathematics, there were four possibilities considered in this area; (1) ethnomathematics should replace academic Mathematics in the curriculum; (2) it should be a supplement to the Mathematics curriculum; (3) it should be used as a springboard for academic Mathematics; and finally (4) it should be taken into consideration when preparing learning situation. Undeniably, the aim of ethnomathematical studies is to help the teacher establish cultural models of beliefs, thought and behavior, in the sense of contemplating not only the potential of the pedagogic work that takes into account the "knowledge" of the students, but also the learning inside the school which is more meaningful and empowering (D'Ambrosio (2001)).

On the other hand, different studies vis-a-vis ethnomathematics were done across the globe. Majority revealed that contextualized teaching and learning of Mathematics differ significantly in terms of understanding the concepts and ideas. Numerous studies on the same aspect were even tried here in our country. Nonetheless, teachers' receptiveness of the idea is still inadequate. This is due to poor background on how to integrate ethnomathematics in teaching Mathematics. With this, the present study attempts to illuminate the same field of study converging on the culture and local practices of the indigenous people of Jose Panganiban, Camarines Norte particularly that of Kabihug tribe. The focus of this study is to determine their ethnomathematics as practiced in their

daily lives and its inclusion to the teaching and learning of Mathematics from a cultural perspective. Specifically, this study aimed to answer the following sub-problems:

1. What are some of the socio-cultural characteristics of the Kabihug tribe?
2. What are the ethnomathematical practices that the Kabihug Tribe of Jose Panganiban, Camarines Norte commonly use in their daily lives along: a). simple counting b). ciphering c). measuring d). classifying e). ordering f). inferring g). modeling pattern?
3. How do they learn these ethnomathematical concepts and ideas that they manifest or use in daily life?
4. How do school children from the tribe use their mathematical concepts and ideas in learning Mathematics in formal schooling?
5. What instructional materials could be developed to integrate the ethnomathematics of the Kabihug in teaching Mathematics in high school?

2. Materials and Methods

One of the purposes of conducting this study is to develop instructional materials uncovering the ideas and concepts of ethnomathematics in teaching and learning high school mathematics through the in-depth information and analysis of the ethnomathematics of the Kabihug tribe. The local practices relevant to the study were to be examined to determine how these are related along the variables being considered such as simple counting, ciphering, measuring, classifying, ordering, inferring and modeling pattern. To strengthen this study, a comprehensible analytical framework was established wherein analysis and findings were organized. This comprises defining the scopes and limits of variables or factors examined including specific terminologies or concepts and providing insights on the philosophy and approaches to be done to handle and interpret the qualitative data.

Essential to the scope of the ideas and principles were the theories collected from the related literature and studies. Hence, the gathered information was studied and analyzed which resulted in the conceptualization of this study. The study was all about the ethnomathematics of the Kabihug tribe specifically their ethnomathematical practices along ciphering, simple counting, classifying, measuring, ordering, inferring, and modeling pattern arising from the environment. The extensive discussion on how they learn the ethnomathematical concepts that they manifest in their daily life is also a part

of this research. The way the schoolchildren use the learned ethnomathematical concepts in studying formal Mathematics was also described to unleash their culture and finally developed instructional materials depicting the local practices of the tribe.

This study employed phenomenological approach study which is within the framework of qualitative research or realistic ontology that covers examination, thematic and understanding. As Bogdan and Biklen (undated) put it, the researcher tries to comprehend the implication of events and interactions to ordinary people in specific situation. It is therefore the subjective aspects of informant's behavior are emphasized in this study since there is an attempt to gain entry into the conceptual world of the informants in order to understand how and what meaning they construct around events in their daily lives. Thus, the goal of qualitative phenomenological research is to describe a "lived experience" of a phenomenon (Lester (1999)).

Data were collected through formal and informal interviews, observations, and group discussions in the natural context to make sense of a situation in the context of meaning. Thus, it produced several interview notes, transcripts and recordings. The data were jotted down and organized by considering field notes, observation, and responses of the informants; and initial analysis was always employed to understand the meaning of the observed behavior and phenomena. This is very important in the process of generating the themes.

The analysis of data was done by identifying patterns, themes, or categories recurrent in the perceived data. The key themes or words of the study include ciphering, classifying, simple counting, ethnomathematics, immersion, indigenous people, inferring, instructional materials, measuring, modeling pattern, and ordering. These terms were defined operationally to make sure that there is a common understanding about the words used. Similarly, it is within the scopes of these meanings that these concepts were used and applied in this study. Furthermore, as a tool to facilitate analysis of the gathered data on the ethnomathematics of the Kabihug, the researcher utilized Spradley's participant observation as well as ethnographic interview questions (Whitehead (2005)). These materials helped in collecting pertinent information which was examined and analyzed and led to the generation of themes.

The significant data cannot be collected all at once. The need to be in the field is imperative in order to capture the different events relative to the development of the study. All the observed details were done through field notes and subjected for interpretation. In order to interpret the hoarded information properly, the researchers utilized the on-line sources and available textbooks

to understand more the extensive idea of conducting this kind of undertaking. To confer its reliability and validity, triangulation, respondent feedback, and series of consultations with the NCIP team and co-researchers were done for several times to arrive at the correct findings and conclusions about the data. These activities helped a lot to arrive with a good output. Figure 1 shows the analytic framework of the study.

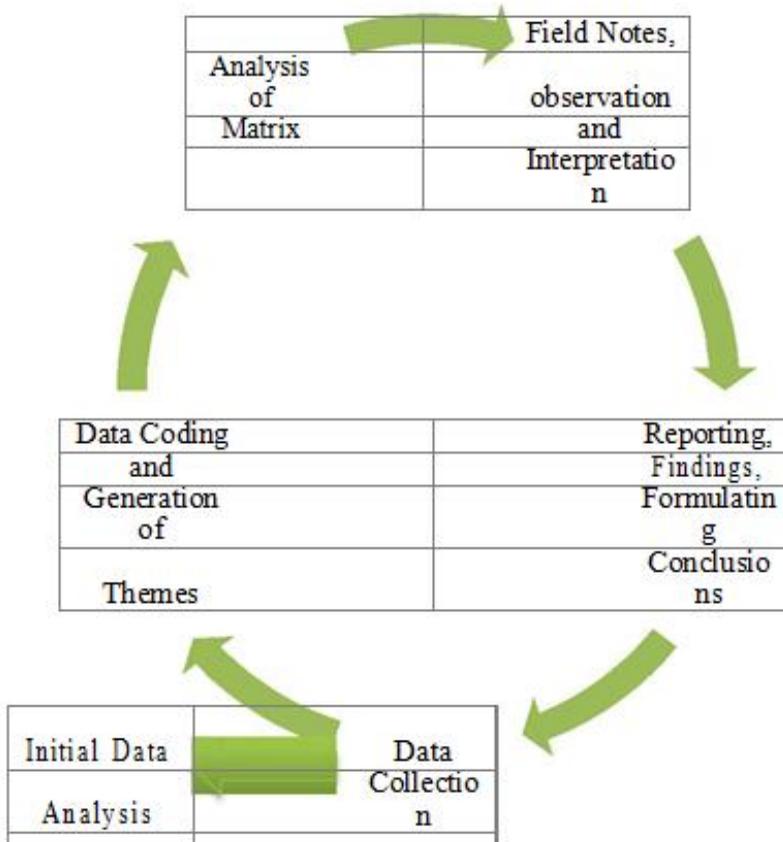


Figure 1: Framework Analysis of the Study.

3. Result and Discussion

The Ethnomathematics of the Kabihug Tribe

The account cited in this study about the culture and local practices of the Kabihug do not mean to generalize or homogenize one's mind in perceiving the context in their own point of view. This is an endeavor to provide ideas on the ethnomathematics of the Kabihug tribe in order to develop instructional material that could be used in teaching and learning Mathematics.

Some of the Socio-Cultural Characteristics of the Kabihug Tribe

The Kabihug are basically farmers who cultivate the rice fields at the settlement or employed by people (lowlanders) outside their territory. *Pangungupra* (coconut cropping), *pagkakabud* (traditional small scale mining), *pakikigapas* (cutting grass), *pangangalimango* (crab hunting), *pagwuling* (charcoal making), weaving baskets among kabihug women, raising hogs, and sometimes *kaingin* are considered as other sources of livelihood. Others would usually find *nito* to sell. *Nito* is an indigenous plant used for handicraft. Aside from Kabihug, they call themselves *mamanide* which at the same time the name given to their local dialect. During the gathering of data, the record shows that the number of pupils presently studying at Osmena Elementary School was thirty (30), no high school student and two (2) college students who failed to continue their courses due to difficulties in coping with their studies and financial constraints. Most elders were not able to experience formal schooling just like some of the parents of the elementary school pupils. Others are not even aware of their age as well as their birthday. There are a few who could not read but they are capable of writing their names. Failure to acquire formal education is considered one of their greatest mistakes in life.

The Kabihug tribe has local practices when it comes to courtship and marriage. A lad would usually convey his interest in marrying a lady by rendering his services to the family of the woman. If they are both ready for marriage, a wedding ceremony will be officiated by one of the respected elders in the tribe and a simple celebration happens during the event. When it comes to childbearing, pregnant women then, are very dependent to the so called *hilot*. The *hilot* is usually a woman who is also a member of the tribe. She tries to identify the approximate time of the delivery of the baby by touching and massaging slowly the mother's womb. The *hilot* uses a sharp stripped bamboo in cutting the umbilical cord of the baby after the delivery and covers it with clean cloth. The placenta or *inulnan* as they call it, is buried on the ground inside the house and is immediately covered with soil. On top of that soil, wood will be burned and small pieces of flat clean stones will be heated enough to be endured by the mother for these will be put on top of her stomach. According to them, this will help remove the unwanted blood inside the mother's womb. Father's would usually sacrifice doing this until the time that the mother can

do it alone by herself. At present, the barangay health unit is encouraging all pregnant women in the tribe to have consultations at the health center. They are also encouraged to practice the family planning method. For this reason, their local practices are slowly vanishing by embracing the ways introduced by the local government.

On the other hand, the Kabihug are fond of chewing "nganga" the reason why they always bring a small bag or *apugan* with sweet tobacco, *buyo* (piper betel), *puti* (lime) and *bunga* (betel nut) in it. Chewing "nganga" is already part of their lives. A day without "nganga" is such a bad day for them.

Another important issue which is part of their culture is that, they do not observe so many occasions. The most important celebration is done during October which is the Indigenous People Week or the tribe's fiesta. Here, the tribe from different parts of the province gathers to celebrate this special occasion.

They also elect their officials among themselves. This is done by voting for a chieftain and seven *kagawad* (councilors). These elected officials are considered representatives of the tribe whenever a meeting or seminar is being called for. The role of the chieftain is quiet crucial because he is in-charge of settling the dispute of his constituents. If the chieftain cannot resolve the conflict within his jurisdiction they seek help from the barangay captain.

Christianity is the predominant religion of the tribe, the Roman Catholic and Born Again Christians. Missionaries are also rendering their service through Bible Study.

Other people would look at the Kabihug with condemnation because of their black color and distinctive appearance as compared to ordinary people living in the low land area. But behind their physique is a marvelous person who possesses aboriginal and unique knowledge that could be a great help in understanding other aspects of life. It is through listening to their voices and understanding their thoughts where a lot of ideas can be recuperated and eventually recognize the essence of the real "them" in the society.

The Ethnomathematical Practices of the Tribe Used in their Daily Lives

A. Counting

Counting various quantities is one of the important human activities in which children take part starting at the very young age. Its main goal is to assign a numeric value to a group of objects. Simple counting is possible

just to indicate that such value exists. In the case of the Kabihug tribe, only few of them had experienced formal schooling, this is the reason why many could not read and write; and one of the consequences is the deprivation of learning from the so-called formal school Mathematics. Nevertheless, despite being less privileged in the field of education, they cannot be tagged as “mathematically handicapped”, because they have their own practices in dealing with real life Mathematics like in the case of counting.

The Kabihug can do simple counting by marking or simple tallying. According to them, through negotiation of meanings, their ancestors created their own mathematical symbols in writing numbers as shown in Table 1.

The symbols can be extended to 14 or more by adding one more mark on the preceding number. If the tallied symbol is already long indicating a large quantity they put a mark at the end of the symbol. Like for example writing 30 using their ethnomathematical symbol, 30 may be written as $\text{lllllllll} \bullet \text{lllllllll} \bullet \text{lllllllll} \bullet$ or $\text{lllllllllllll} \bullet \text{lllllllllllll} \bullet$. They tried to put a mark after every 10 or 15 tallied values to avoid confusion in tallying large number. The mark is not necessarily the dot shown in the cited example. The following activities of the tribe were also witnessed along simple counting; the concept of division was used in the equal sharing of rice through the idea of distribution; the concept of multiplication was used in doubling in computing the earning of income especially in selling *nito* and *pagkakabud*, counting money, marking and tallying during the tribe’s election.

Table 1: Simple Counting of Kabihug Tribe Using the Ethnomathematical Symbols.

The symbols learned from formal school	Counting in Ma-manide Dialect	Kabihug ethnomathematical symbol
1	Supeg	I
2	Dawha	II
3	Tatlu	III
4	Apat	IIII
5	Lema	IIIII
6	Anum	IIIIII
7	Pito	IIIIIII
8	Walu	IIIIIIII
9	Siyam	IIIIIIIII
10	Sampu	IIIIIIIIII
11	Onse	IIIIIIIIIII
12	Dose	IIIIIIIIIIII
13	Trese	IIIIIIIIIIIII

B. Ciphering

Ciphering is a written code in which the letters of a text are replaced with others according to a system. This is somewhat similar to the way the tribe do ciphering. The activity involves signs, symbols and human gestures which are other ways of conveying message to their fellow Kabihug.

The ethnomathematical practices of the tribe along ciphering were also observed through the following local activities. First is the use of *tuos* as sign if the family is not around which can be decoded by other members in the tribe. Second is the mode of shouting for *tingal* in conveying the message that a member of the tribe has passed away. Finally, the mode of shouting for *ulaw* can be ciphered which means that the tribe should assemble because a meeting is being called for.



Figure 2: The "Tuos" Placed Near the House if the Kabihug is not Around.

C. Measuring

The purpose of measuring is to quantify something. Through this, the object being measured can be described properly because of the numerical value and unit associated with it. The local practices of the tribe in measuring show a stimulating connection in the field of ethnomathematics, like for instance the elders would usually use the environment to determine the time. The Kabihug, use the sound produced by a *kalaw* bird as time gauge aside from the sound produced by roosters early in



Figure 3: One of the Women in the Tribe Uses her Fingers and Arms in Measuring while Stripping the *Karagumoy* Leaves.

the morning. Old women from the tribe use the sun to determine time through the shadow cast by objects. Another exciting activity among the tribe in measuring is applied in cooking rice. A woman used her bare hands in measuring the rice to be cooked for her family. She also used her middle finger to measure the water needed in cooking. The same story goes with another elder when she used approximation in identifying the volume of rice that will fit in a large pot after cooking. Another measurement used is comparing 20 pieces of grain of *palay* in weighing one *bahay* of gold. Using body parts in determining the distance of one tree from another in planting and measuring the length and width of the *karagumoy* leaves for weaving basket called *apugan* is another interesting activity of the tribe that could serve as venue in appreciating the real life context of Mathematics in measuring.

C. Classifying

Putting objects or things based on its common characteristics is a manner of classifying. It usually provides model for organizing things in the real world, thus it promotes logical thinking. Classifying objects is also eminent in some of the activities of the tribe. It can be observed around the community through the way they place things together specially in planting. They group the crops according to how they grow and apply fertilizers, making the plants grow healthy and eventually produce a good harvest. Classifying can also be observed in charcoal making or “*pagu-*

uling". One of the members of the tribe said, that a high quality kind of charcoal is called bag-as which is sold at P300.00 per sack while the low quality is only P200.00. Classifying charcoal whether it is bag-as or not before selling is very important. Bag-as charcoal is practically longer to consume in cooking compared to ordinary charcoal which is easily burned up due to the poor quality of wood. But because of the law prohibiting people from cutting trees everywhere, this kind of activity is rarely done by the tribe nowadays to protect the environment for possible occurrence of any calamities. The same local activity was also noticed in selling crabs. The crabs were also classified according to their size (large, medium, and small). Medium and big sizes are sold to the lowlander at P150 per kilogram while the small ones are left for personal consumption.

E. Ordering

Some of the stimulating local practices of the tribe can be observed through ordering. This paper considers ordering as the arrangement or sequence of things and activities of the tribe following some rules or reasons. The observed local practices in ordering are the activities done in *pangnganga* and the common practices in planting.

One of the activities of the Kabihug which is considered part of their routine is "*pangnganga*". The observed collation of activity in *pangnganga*, such as putting lime in piper betel, and chew it, chewing $\frac{1}{8}$ of betel nut and eating a quarter of sweet tobacco is a part of their culture which is very important in their daily life.

On the other hand, the common practices in planting among Kabihug have significant ethnomathematical concept and idea that can be drawn. The observed collation of activities are the following: 1) making bamboo stick to guard the plant, 2) putting available fertilizer around the roots, 3) harvesting the crops and vegetables, 4) weighing the crops and vegetables, 5) selling the harvest to the local market and 6) earning money. Notice that each activity involves ethnomathematics that guide them in doing their local routines.

F. Inferring

Doing inference in Mathematics is the act or process of deriving logical conclusions from premises known or assumed to be true. The laws of valid inference are studied in the field of logic. However, in this study inferring is used in the context of derived meanings from the observed patterns in the environment. Drawing inferences from the observed information is a basic human activity to interpret events in daily lives. In the case of Kabihug, when the events happened as a result of inferring, they become true for them and eventually become part of their belief and culture.



Figure 4: "Pangganga" Part of the Daily Routine of the Kabihug.

Inferring is also observed in the local activities done by the Kabihug, like for instance predicting weather through cloud formation and the sound produced by owl; inferring if a place is conducive for building a house and determining if a certain place is good for *pagkakabud* or not. These are few situations that can be adapted to connect the lessons in Mathematics especially in the field of Statistics.

G. Modeling Pattern

Observing the environment and surrounding where the community settles can enrich one's mind in the real context of ethnomathematics. In this study, the patterns considered are produced by nature and the "man-made" creations by the tribe.

Patterns are imminent in the games played by the Kabihug children like the *pekong cruz* and *sangkayaw*. There are also patterns observed in farming like the arrangement of palay in a parallel manner. The pattern produced after weaving small baskets is another remarkable application of ethnomathematics. Notice that the art produced after weaving the *apugan* has a great mathematical significance. They made designs of different shapes even without knowing the name of the shapes in geometrical terms. These designs can also be associated to tessellations in Mathematics.

The contexts cited in this study in numerous activities of the tribe can be connected to Mathematics taught in school in several mathematical



Figure 5: Some Patterns Observed in the Kabihug Settlement.

concepts like geometry, arithmetic, statistics, and algebra in order to make Mathematics more stimulating and meaningful to study on the part of the students. As a result, this could be a great opportunity in bringing a change in the outlook and perspective of teachers and students in teaching and learning Mathematics. As D'Ambrosio (2001) puts it, basic understanding of ethnomathematics allows teachers to expand their mathematical perceptions and more effectively instruct their students.

Learning the Ethnomathematical Concepts and Ideas of the Kabihug Tribe

Learning is acquiring knowledge or developing the ability to carry out new behaviors. People used to think that learning usually occurs in the school environment only, however, this is not always the case because much of the human learning happens outside the classroom and the learning continues throughout their lives which are the result of their everyday experiences in life.

Knowing how the practices learned by the tribe was relatively difficult. The responses of the informants were ambiguous because they themselves could not give an accurate picture of the learning process. However, the common standpoint is that, most ideas were handed down to them by their ancestors which are results of careful and keen observations, reflections and words from

the mouth of the elders. Other learning came from attending various seminars conducted by the government and other private entities. Others were based on their intuition that gave them ideas on how to perform a particular task; and through constant doing of things or repeated activities.

According to the tribe, there are local practices that cannot be considered as aboriginal compared before. This is due to the fact that changes take place during the process since there is a need to adapt to the environment. Bishop as cited in the book of Teaching Mathematics by Davis (1999) emphasized that, "Culture is constantly in process of being recreated as it is interpreted and renegotiated by its members. In this view, a culture is as much a forum for negotiating and re-negotiating meaning and for explicating action as it is a set of rules or specifications for action". This way, people tend to adjust to new circumstances and learn to admit responsibility for their behavior. Vital to this idea is the work of Lev Vygotsky on social constructivism which explains that a group of people usually constructs their own knowledge, collaboratively forming a small culture of common objects with shared meaning. The foremost activity of the acquisition of language and knowledge is through social interaction and consequently negotiation of meaning. Thus, learning as described by Hmelo and Evensen (undated),

Learning process is a process of enculturation, emphasizing the socio-cultural setting and the activities of the people within the setting. In other words, learning is not an accumulation of information, but a transformation of the individual who is moving toward full membership in the professional community.

The idea is further supported by Albert Bandura on his Social Learning Theory (Gines et al. (1998)), which says that social behavior is learned through imitation with what others do. The observed information from other people, events or things are processed which influence ones action or behavior. Thus, the learning of the ethnomathematical concepts is constantly evolving since learning is a continuous process.

Another significant aspect considered on how the ethnomathematical concepts learned by the tribe was through their "lived experiences". Human learning has proven itself to be tremendously capable at adapting to the possibilities of existence wherein one never knows exactly what will be learned. Learning for them is through constant acquaintance or exposure on what they do every day, they become familiar with it which eventually results in discovering a way on how things can be done simpler; others call it habituation, a belief that learning is an individual, self-contained phenomenon.

Other practices were also learned from other people and organizations who invited them to participate in various seminars that would improve their way of life by adapting other opportunities but will not imperil their existing culture.

Using the Mathematical Concepts and Ideas in Learning Mathematics in Formal Schooling of the Schoolchildren

The application of the ethnomathematical concepts of the Kabihug tribe has a lot to offer in dealing with the basic concepts in Mathematics both for elementary and secondary. Data gathered were based on observations and transcribed recording from formal and informal interviews with the Kabihug children and the elders. Furthermore, the Mathematics teachers of the Kabihug children play a significant role in this study since they were asked to describe how the pupils applied their culture in learning Mathematics.

Based on the conducted interview and observation, most school children were using tallying, marking or the ethnomathematical symbols in performing the four fundamental operations. Counting fingers to get the sum or difference of two or more numbers were also observed among the children. However, this is limited for small quantity only. The teachers testified to this idea since this is observable on the part of the students every time they are taking Math test. Similarly, there are lessons in Mathematics where mathematical concepts learned from the tribe can be applied along measurement. Using their body parts, for instance, in measuring length or distance of some objects. The idea learned from the tribe like the sounds produced by the birds and the shadow cast by a tree or anything for that matter can even apply to some lessons in Mathematics like approximating the time. Patterns around the environment have a lot of connections in the field of geometry. Citing some concrete examples of the geometric figures that can be found and observed in the settlement is another way to grasp ideas on how mathematical concepts and terms can be illustrated. The instrument used for *pagkakabud* called *pabirik* for instance, was mentioned by the children as best example in illustrating the idea of a circle.

Likewise, the frame of the *nipa* hut during the Indigenous People's Week illustrated different geometrical concepts like, line segments, intersecting lines, vertical lines, parallel lines, vertical angles, adjacent angles, acute angle, obtuse angle, oblique triangle, point, line and plane. Somehow, these observed objects around the settlement offer geometrical ideas to the schoolchildren in dealing with school Mathematics. Even the game called *pekong cruz* drawn on the ground by Kabihug children suggests the same geometrical concepts cited above. Quadrilaterals like squares and rectangles were also formed af-

ter connecting the line segments to one another. Similar concepts are applied to the materials used in making *sangkayaw*, also played by Kabihug children, when triangle was observed in the material. These are just few practical examples where concepts in Mathematics were concretized by children in learning Mathematics particularly in geometry. Consequently, logic and reasoning are important mathematical concepts that can be linked in playing the game in order to win; these are actually foundations in learning Mathematics subject.

The Instructional Materials Integrating the Ethnomathematics of the Kabihug in Teaching Mathematics in High School

Contextualizing Mathematics meaningfully is such a challenge on the part of Mathematics educators nowadays. This is a growing concern not only locally but also globally. In order to address this problem, this study attempts to present an instructional material disclosing the ethnomathematical practices of the Kabihug tribe in Camarines Norte in dealing with some of the mathematical lessons in high school. This is conceptually done by considering relevant bases and guidelines to construct good materials in the hope of helping our Mathematics curriculum. The purpose is to provide resource materials that will engage students actively in meaningful and relevant experiences in accordance with the government's philosophy in education which is "Education for All". Thus, a culture-sensitive material that bridges students' home cultures and the academic culture of school Mathematics was practically developed. This idea is supported by Bishop (1988) when he explained that, the cultural background of the students are already sufficient from which mathematical concepts can be developed and the curriculum should be aligned with culture for learning opportunities to be enriched. This is further supported by Refugio (2010) , Adam (2002) , Lipka and D. A. Irhke (2013) , when they dealt on the inclusion of ethnomathematics in the teaching and learning process in mathematics or in mathematics curriculum as a whole since they find it to be relevant in the thinking process of the students. This study considered teaching guides, lesson plans and worksheets intended for both teachers and student which reveal the interesting culture of the tribe in the milieu of informal Mathematics as the instructional materials developed. The researcher was also inspired to delve more about the concept under study due to the findings of Education Committee (EDCOM, 2006) report that revealed,

The public schools have hardly met the needs of tribal Filipinos for three reasons: inaccessible school; an inflexible schedule which fail to accommodate the economic activities of the tribal learners; and curriculum and instructional materials which are irrelevant to the needs or cultural characteristic of the people. Their teachers generally from the lowlands are unfamiliar with the

ways of life of the tribal groups. The requirement that DECS own school sites prevents the building of schools on ancestral lands.

With these discoveries, this material will somehow help teachers to take into account and recognize the culture and situation of school children who belong to tribal groups. Hence, considering diverse learners in delivering the lessons will make a difference in the teaching and learning process. Other significant resources such as the K-12 Curriculum Guide (July 19, 2012 version) textbooks and modules for Grades 7 and 8 are considered in the preparation of this material. The suggested materials for teachers here are of two parts (I and II). The first part is a teaching guide on how to introduce different concepts in Geometry by considering the ethnomathematical concepts and ideas used by the Kabihug tribe. While the second part is a sample of a semi-detailed lesson plan, good for one session that could serve as an example in developing student friendly contextualized teaching-learning process regarding the lesson applying the ethnomathematical practices of the tribe. Moreover, a sample project for students was also included to give idea on how to conceptualize a project dealing with the local context of the students in order to appreciate more the real life application of Mathematics. The teacher can modify this material so that it will match or fit to her lesson. Sample worksheets intended for the students are also presented here as part of developed instructional material. These worksheets can be adopted to enrich their understanding about the local context of Mathematics.

4. Conclusion

Based from the findings of the study it is concluded that the socio-cultural characteristics of the Kabihug tribe in terms of living condition was basically related to farming due to the fact that majority of the elders were not able to experience schooling and they have their ancestral domain to cultivate. The way of life observed was mostly related to their culture and local practices. And their typical day of living was seen to be very simple in the rural area.

The ethnomathematical practices of the Kabihug tribe along simple counting were tallying or marking, counting fingers, concept of equal sharing in the harvest rice, the idea of doubling in selling *nito*, tribe's election and approximating the income in *pagkakabud* can be linked to the four fundamental operations such as addition, subtraction, multiplication and division. In ciphering, local practices were putting of tuos and decoding the meaning of *tingal* and *ulaw* which can be associated to analysis in solving Math problems. Measuring were observed in determining the time through the sound produced by birds

and shadow cast by objects; in cooking, in weaving *apugan*, and planting trees through the use of body parts; and in weighing gold through comparing it to 20 grains of *palay* in weight. Thus, these activities can be related to the following concepts in Mathematics such as, system of measurement, conversion of units, conversion of time (century, decades, years, months, weeks, days, hours, minutes, seconds), metric conversion factors for length, mass, areas, volume, ratios of measurement, approximation and rounding off numbers. Classifying was also observed in the ethnomathematical practices of the tribe in planting, selling crabs and selling charcoal. These practices can be associated in operations on sets. The practices observed in ordering were the activities in *pagnanga* and the common practices in planting crops among the tribe. The ideas that can be derived from the activities can be linked to fractions and decimals, arranging fractions in descending or ascending order, simple problems on ratio and proportion, and profit and loss. Inferences were perceived in observing cloud formations, sound produced by owl, results of doing rituals and observing the growth of plants in a particular area. Hence, these practices can be connected to proving in geometry, simple topic in logic and statistics. Finally, the observed practices along modeling pattern were found in the games played by the Kabihug children such as *pekong cruz* and *sangkayaw*, farming in the settlement, the weaving of *apugan* and other materials used by the tribe. These practices offer connections to the study of geometrical concepts and ideas, triangle, quadrilateral, parallel lines, perpendicular lines, tessellations, etc.

On the other hand, the learning of the ethnomathematical practices is based from the following. First, the concepts and ideas learned were basically originated from constructed knowledge, formed culture and negotiated meaning. Second, the ethnomathematical practices were handed down from generation to generation. Third, their "lived experiences" allowed them to be more creative in dealing with a particular situation. Fourth, their learning was the result of imitating what others do. Fifth, others are given the chance to acquire basic education in elementary. Sixth, the situated cognition supports the idea of learning based from their intuition since the knowledge is already imbibed by them. And finally, their attendance to trainings and seminars gave them ideas to improve their way of life without affecting their culture.

In addition, the learning of some concepts in Mathematics learned from school is through the use of the ethnomathematical practices like the application of the ethnomathematical symbols and the counting of fingers in performing the four fundamental operations. The use of body parts in measuring is a way to understand measurement and approximation. Ethnomathematical ideas applied in classifying are ways to understand the mathematical concept of set. And the patterns around the environment are used to understand some

geometrical concepts and ideas.

Finally, the developed instructional materials depicting the ethnomathematical practices of the tribe can be utilized in teaching high school mathematics. This can lead our students in constructing their own sense-making experiences in the classroom, since the representation of the pure concept is more tangible and it offers rich applications in cultural context.

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