Integration of Cultural Practices in Teaching Mathematics

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Abstract
The interdependence between culture and education is not new to educators anymore. Educators acknowledge the fact that culture defines and gives identity to education while education strengthens culture. Indeed, these two disciplines are inseparable and complementary. However, cultural relevance in mathematics instruction is seldom evident. This qualitative-quantitative study designed lesson plans that drew upon the context of students' cultural background and experiences. Primarily, this study presented several ways on how teachers, especially those with less technological opportunities, can make use of locally-available materials. Interviews and observations were conducted to determine the cultural practices along traditional games and livelihood activities of a certain cultural group. The identified mathematical practices were examined to develop appropriate and culturally relevant lessons which were implemented to two groups of students to determine its effects on students' conceptual understanding and interest towards Mathematics. Results revealed that there is a significant difference between the performance of the two groups of students, within the considered constructs, before and after being exposed to culture-related activities. Inclusion of the cultural aspects of students in mathematics instruction has deepen their understanding of mathematical concepts, boost their interest in mathematics and has widen their view of their own culture by making meaningful connections between mathematics and their cultural practices. Furthermore, the role of community as co-partner in the teaching and learning process was maximized when they serve as key resource persons. Hence, the researcher encourages educators to become culturally responsive in instruction.

Keywords: Cultural practices, traditional games, livelihood activities, locally-available materials, culturally responsive instruction.

Introduction

Mcleod (1994) stated that students tend to dislike math as they move from basic to higher mathematics. Peterson (2005) opined that this was brought by the anxiety and fear of numbers that have been developed to students due to pedagogical approaches that are based only on route calculations, repetitive drills, and endless worksheets. Such teaching approaches failed to match with students' learning styles and interest resulting to their low academic performance as affirmed by Tate (2005). In support of this, Enukoha (1995) stated that students perform poorly in mathematics because both the content and the method of teaching mathematics do not reflect the cultural environment of the learners. Hence, there is a need to bring in a method that will personally involve students to arouse and sustain their interest and result in a better academic performance. With this notion, Ladson-Billings (1994) encourage teachers to acknowledge students' significant cultural references and experiential filters in delivering their instruction. In this way, students' ideas and strengths will be empowered making them copartners in the teaching and learning process. This is in parallel to the standards set by the National Council of Teachers of Mathematics (NCTM, 1991) that the key to effective teaching is to understand students' mathematical thinking, interest, lived experiences, cultural references and how these constructs affect all aspects of learning. Consequently, a new teaching approach was presented, described as culturally responsive instruction.

Culturally responsive instruction was defined by Gay (2002) as an approach to teaching that recognizes cultural components and experiences of students in their immediate environment as conduits to facilitate teaching-learning process. When students come to school, they bring with them some values, beliefs, practices and concepts that they acquired at homes or within their communities. These acquired practices were confirmed by Bishop (1994) to be mathematical in nature. Specifically, these practices are mathematics in the community, symbolic systems, practical construction techniques, specific ways of reasoning and other cognitive activities which can be translated to formal mathematical representations as expounded by D'Ambrosio (1985). Indeed, mathematics is not a culture-free subject. According to Zincheko (1989), constructivist and cultural people around the world are endeavoring to make education culturally based. They opined that mathematics divorced from culture can never sustain itself. Thus, teachers must widen their view of mathematics and let students be exposed to activities grounded within the context of students' cultural backgrounds. Taking this into account, students will have the opportunity to experience a unique learning environment that nurtures their identities and culture as part of learning mathematics.

Eglash (1999) studied the mathematics in the designs of traditional bead work and basket weaving in native cultures. Massarwe, Verner & Bshouty (2012) studied the relationship between geometry and culture in the construction of geometric ornaments. Sheets (1999) also suggested initiating cooperative learning groups and assigning students to projects that involves issues or concepts within their community. In the Philippines, Rubio (2016) identified the ethnomathematical practices of the *Kabihug* tribe along simple counting, ciphering, measuring, classifying, ordering, inferring and modeling patterns arising from their environment. The identified practices were then integrated to mathematics lessons intended for the *Kabihug* students. Indeed, culture is rich with mathematical concepts that students must see to widen their mathematical perceptions. Moreover, in an article written by Cheryl Ernst, featured in Mathematical Association of America, Linda Furuto (2010) stated that she integrates culture by exposing all her students in the field to discover the relationship between mathematics and real world. One of the activities conducted by her was when they aboard a two-hulled canoe in Hawaii. They investigated the traditional way-finding techniques used by their ancestors like celestial navigation to arrive at their destinations without knowing much about complex mathematics. According to Furuto, first-hand experiences tell her that culture integration engages people in mathematics. She also added that it is indeed important to know and learn the math written in textbooks. However, knowing how their ancestors sailed thousands of miles across the Pacific Ocean without any kind of modern navigational tool is equally important for the students. All these creative and innovative activities made mathematics exciting and pleasurable to learn.

On the other hand, not only students are seen to benefit from this new approach. Teachers, especially those in the upland or urban areas will have access to a variety of cultural resources to be used in teaching. This allows teachers to become resourceful in using the locally-available materials since immediate environment of school can offer unexpected resources that will improve the quality of instruction. Additionally, teachers will gain insights on how culture, social interactions, family and everything that surrounds the learner affect their attitude and intellectual development. According to Feiman, Nemser and Melnick (1992) such insights enable teachers to draw on those experiences to represent school knowledge to their students meaningfully and embed learning activities in contexts that are familiar to students.

However, despite of several research groundings, integration of cultural components in mathematics instruction is seldom evident, especially in the Philippines. Some educators have not seen yet the need for it to be implemented disregarding its potentials in enhancing mathematics curriculum. But, according to Ladson-Billings, inclusion of these cultural aspects is a critical need in mathematics instruction that teachers must not neglect. Delpit (1995) also argues that culturally responsive teaching must be an integral element in the mathematics program especially for the urban students. Subjects like language, music and arts, physical education and social studies have already considered inclusion of these cultural components but not much in mathematics. Four (4) probable reasons were presented by Ukpokodu (2011) why mathematics teachers are still not engaged in culturally responsive teaching. First, most teachers view mathematics as culturally neutral. Mathematics is too abstract for it to be partnered with cultural elements. Culture and mathematics are two divergent disciplines as believed by most teachers. Second, textbook-based instruction is dominant. In the Philippines, the content of instruction was determined by textbooks and competencies indicated in the curriculum. The teachers were pressured to cover all topics specified in each quarter. So, inclusion of such cultural components is not much given attention. Third, curriculum is standardized. Due to high stakes testing, teachers teach just to gain high results from the students improving only test scores but not the quality of learning and instruction. Lastly, the lack of culturally responsive mathematics teaching models to emulate. Since culturally responsive teaching is new, only few materials or references yet are available that will help them structure a culturally relevant instruction. Many teachers are still unaware to use it in teaching mathematics efficiently. As a result, teachers are unable to implement this new approach.

To address this issue, the researcher attempts to connect culturally relevant content to mathematics by disclosing the cultural practices of the people in San Isidro. This is pedagogically done through identifying significant cultural practices that exhibits mathematical concepts. These practices are along traditional games and livelihood activities.

This notion is supported by Rosa and Orey (2011) that infusing mathematics with familiar cultural contents makes mathematical knowledge meaningful and relevant to students. These are all based from the assumption of Gay (2000) that when academic knowledge and skills are situated within the experiences and cultural background of students, they are more meaningful, have higher interest appeal and are learned more easily. Thus, the researcher tries to build a successful link among mathematics, culture and community. Primarily this study aimed to seek answers to the following questions:

1. What cultural practices in San Isidro can be integrated in mathematics instruction along;
   a. traditional games; and
   b. livelihood activities?
2. What are the effects of the lessons integrated with cultural practices to students:
   a. conceptual understanding?
   b. interest towards Mathematics?

Methodology

This study utilized qualitative and quantitative research design. The qualitative approach was used in identifying the cultural practices in the locale and in the analysis of students' responses in interviews. The quantitative approach was done through pre-experimental design with two experimental groups. Thus, no comparison between the two groups was done. For the area of study, an upland area and school, Barangay San Isidro and San Isidro National High School, respectively, were purposively selected for the goal of providing pedagogical ways in integrating culture in mathematics instruction resourcefully to teachers with less technological opportunities.

The preliminary data were collected through formal and informal interviews, and observations in the upland community using a modified interview guide questions from the works of E. Lynch & M. Hanson (1998) on developing cross-cultural competence. The informants were elders, livelihood workers and students that were purposively selected for the study. After a month of exploring the culture of the locale, the field notes and responses of the informants were collated and analyzed. The cultural practices are limited along traditional games and livelihood activities. Then, the cultural practices that were identified mathematical were carefully integrated into mathematics lessons in lined with the competencies given by the Department of Education for the Enhance Basic Education Curriculum also known as K to 12 for Grades 7 and 10 covering the topics under Geometry and Probability. These were thoroughly examined by experts of the same field to ensure the correctness and appropriateness of each lesson. Revisions were made in accordance with the jurors' recommendations for the said learning plans and activities.

Before the implementation of the lessons, a teacher-made pretest was administered to both groups of students. This was pilot tested and was found to have internal consistency. Likewise, a modified Mathematics interest inventory checklist from the works of Dela Rosa (2000) was given right after the exam. Both were administered again after implementing the lesson to know the effects of culturally relevant lessons to students conceptual understanding and interest towards mathematics. To obtain more in-depth information, focus group discussions, with randomly selected students in both groups, were also conducted.

Cultural Practices along Traditional Games

The following are the most mentioned traditional games played by the elders and of the students in the locale. The first game is "turubigan" widely known as *Patintero* in the Philippines. Its name came from the root word "tubig", which means water. This is used to draw the lines of their playing field that is marked off in a rectangle about five or six meters, divided into four equal parts. *Turubigan* is played by two groups, with at least four (4) members each. The leader of each group must do *bato-bato-pik,* widely known as *rock-paper-scissors* to determine which group will be the *taya* or *"It"* and the *madurulag* or the *"runner"*. The group assigned as *taya* will arrange themselves, showing permutation, in each line to guard the entry points which represent parallel lines. The goal of the *taya* is to block the runners and catch at least one of the runners. The goal of the *madurulag* is to surpass all parallel lines in the playing area and be back at the starting point without being caught by one of the *taya*. If one player is caught, the two groups will now switch roles. The second game is *Piko't bado*. The players will draw their playing area that will look like a *bado or* a shirt. Each player must have their own *pamato,* usually a small stone*,* that is thrown in each shape in the playing field. The goal of the player is to jump in all shapes back and forth without falling and be able to get the stone from where it was thrown. The figure below shows children playing *Piko't bado*.

Figure 1. Children while playing Piko't bado.

The arrangement or order of the players in playing *piko't bado* exhibits permutation. The throwing of *pamato* (stone) in the playing field to make *balay* also involves probability wherein the players have 9 possible shapes where the stone can land on.

Another game is called *Ikus-Kino*. This is played by two (2) or more groups with at least five (5) members each. The leader of each group will choose one member as the *ikus or* cat and another member as the *kino or* mouse, this already involved probability since the players don't have the idea who among them will be picked as the *ikus* or *kino*. All members of the group will stand one behind the other forming a line, each holding the waist of the one in front. Permutation will now occur in this scenario. The *ikus* and *kino* must be on the endpoints of the line and the other members must arrange themselves between the *ikus* and *kino*.

Indian game is played outdoors by both male and female players. It is usually played during copra production o *paglukad*. Half of the coconut shell or *binungan* is used to play this game. The goal is to flip one coconut shell and aim that the coconut shell shows its outer part while the open part of the shell touches the ground. The concept and the goal are just similar to flipping a coin in a typical probability discussion. Another game played during copra season is *Siripaan Binungan*. The objective of the game is to kick a half coconut shell (*binungan*) towards a small circle drawn about 1 to 2 meters far from them given with three chances.

Siklot is like Jackstone. The only difference is that they use small stones or pebbles instead of jackstone stars as shown in figure 3.

Figure 2. The Students while Playing Siklot

The game is played by grabbing a specific number of stones at a time which demonstrate combination. Similarly, in the game *Dulay-dulay,* the players are sitting on the ground or floor in a circular formation. The goal of the *taya* is to leave the stone behind a player without being noticed and will go around the players and go back to where he put the *balay* or stone.
Table 1 shows the summary of the cultural practices that were identified mathematical along traditional games.

Table 1. The Cultural Practices Along Traditional Games

Traditional Games	Cultural Practices	Mathematical Concept
Turubigan (Patintero)	Having Bato-bato-pik before the start of the game	Probability (Game of Chance)
	Selecting the members of the group	Combinations
	Arranging the members of the *taya* to stand on the lines.	Permutation
	The starting line and the end line of *turubigan* playing field.	Parallel Lines
	The two lines that crossed at the center of the playing field.	Perpendicular Lines.
Ikus-Kino	Choosing of the player to be the ikus or kino	Probability
	Selecting the members of a group.	Combination
	Arranging the members of each group between the *ikus* and *kino*.	Permuataion
Indian Game	Flipping one coconut shell and aiming that the *binungan* will show its outer part while the open part of the shell touches the ground	Probability
Siripaan Binungan	kicking *binungan* towards the small circle in three chances.	Probability
	Chances that a player will receive a punishment	Probability
Siklot	Arranging the players in a circle.	Circular Permutation
	Getting a certain number of stones at a time.	Combination
Piko't Bado	Order of the players in playing the game	Permutation
	Throwing of *pamato,* without looking at each shape in the playing field of *pikot* bado, to get *balay*.	Probability
	Throwing of pamato to a certain area in the playing field that indicates their level in the game	Points
Dulay-dulay	Arrangement of the players in the circle.	Circular permutation
	Chances that the *stone is* put at the back a player.	Probability

It is observed that the dominant concept falls under permutation, combination and probability. These topics are discussed during the third quarter as indicated in the K to 12 Mathematics Curriculum Guide for Junior high school, specifically for Grade-10. These practices were carefully integrated to the lessons to match the level of understanding of the students and avoid additional confusions since they were not used to the said approach.

Cultural Practices along Livelihood Activities

The first livelihood observed in the locale is *sinamay* weaving. *Sinamay* is woven from the processed stalks of the Abaca tree, a banana palm that is native in the Philippines. In San Isidro, *sinamay* weaving is one of the major sources of income of the families. Below shows a woman weaving sinamay in an *abulan*, a special weaving machine made of scrap woods.

Figure 3. The Sinamay weaver while Combing the Abaca Strands in an *Abulan*.

It is noticeable that the arrangements or placements of the abaca stands, the colors that they use, the arrangements of the strands in straight lines which are also equidistant from each other illustrate geometrical concepts.

Next is *banig* making. *Banig* is a handwoven mat made of *karagumoy* leaves**.** The *banig* is made from dried leaves that are sometimes dyed before being cut into strips and woven into a mat. The students discovered that the selection of colors involved combination since the arrangement of the colors in each *banig* does not matter as long as the colors used are distinct in each *banig*. Each strip of *karagumoy* leaves represents line.

A *banig* maker will start making the corner part of the *banig* instead of starting at the middle. This makes the banig easier to move without getting disassembled making sure that the adjacent sides or consecutive sides of the *banig* are perpendicular, to achieve a perfect rectangular-shape *banig*.

Figure 4. An unfinished banig or mat.

Similarly, *Abaniko* making shows concepts in geometry like intersecting lines, vertical lines, angles and other geometrical figures. *Abaniko* is a hand-held fan made of *anahaw* or round-leaf fountain palm. Figure 5 shows the three stages of *abaniko* making.

Figure 5. Three phases of Abaniko making

Another major source of income in the locale is *Paglukad* or Copra production. This is done year-round with an interval of every two months. Copra can be obtained by separating the coconut meat from the whole coconut shell followed by sun drying and smoke drying for about 6 to 8 days as seen below.

Figure 6. Agunan Used in Smoke Drying of Copra

All of them, especially the boys are helping in *paglukad*. The practices within copra production that are found mathematical are in terms of collecting the coconuts where there's a big chance that a farmer might get a spoiled coconut from a set of coconuts. Aside from copra production, they also plant crops like vegetables and root crops but mostly rice. This is basically for their daily consumption and sometimes, whenever possible, they try to sell it for additional income. Farmers usually plant in parallel lines for many reasons, one of these is for better weeding and easy harvesting. The figure below shows cassava planted in parallel rows.

Figure 7. Kamoteng Kahoy (Cassava) planted in Parallel Rows

Lastly, Carpentry or construction works. This is also a work for men. The researcher took time to visit a construction site. It is very evident that there are several geometrical figures that can be found in a construction site. The geometric figures were intersecting lines, parallel lines, and parallel lines cut by a transversal producing pairs of angles. Even the wall studs of the house are representing parallel lines.

Table 3 shows the summary of the cultural practices that were identified along their livelihood activities with their corresponding mathematical concepts.

Table 2. The Cultural Practices along Livelihood Activities

Livelihood Activities	Cultural Practices	Mathematical Concept
Pag-abol or Sinamay Weaving	Arranging the strands in a straight line which are equidistant to each other.	parallel lines
	Transferring the Sikwan side by side perpendicular to the parallel abaca strands	Parallel and Perpendicular lines.
	The *surod* intersecting the abaca strands in the middle to make the strands still in line.	Perpendicular lines
	Combining colors of the *rotex* in sinamay	Combinations
Banig or Mat Making	Edge of *karagumoy* leaves	Line
	The banig itself	Plane
	The intersection of the edges of the *karagumoy* leaves	Points
	Selecting colors of the banig. Arrangement of the colors is not important.	Combinations
	Making the first two consecutive sides perpendicular	Perpendicular lines
Paglukad or Copra Production	Chances that you might get spoiled coconuts in 50 katibo or pieces of coconuts.	Probability
Abaniko or Fan Making	Choosing of colors every *abaniko* regardless of the arrangement.	Combinations
	Crisscross patterns in *abaniko*	Angles and Intersecting Lines
	Chances that a customer will choose the 10-peso abaniko from other abanikus .	Probability
Construction or Carpentry	intersecting woods visible in scaffolding	vertical angles, transversal
	Ladders	Parallel lines and transversal
	Wall studs	Parallel
	Roof frames	Angles, perpendicular, Parallel Lines and Transversal Lines
Farming and Crop Production	Planting in parallel rows	Parallel lines
	Combination of crops to plant	Combination
	Arranging the plants to be planted	Permutations

As reflected in table 2, the cultural practices were linked to its corresponding mathematical concepts. The third column shows that most practices had displayed concepts in geometry. Pedagogically, the lessons developed integrated with cultural practices along traditional games and livelihood activities were anchored on the theories of Kolb (1984) and Vygotsky (1978), experiential and socio-cultural learning theories, respectively. The curriculum set by the department of education in the Philippines also served as guide to the researcher, specifically on crafting some parts of the lessons. Section 5 of RA 10533 known as the "Enhanced basic Education Curriculum" served as the legal base stating that the curriculum shall be learner-centered, culturally responsive and contextualized enough through localized lessons.

These lesson plans contain four essential features of a culturally responsive instruction; (1) Community-based learning. According to Scott (2000) a culturally responsive instruction, without community involvement, will never be successful. A community can offer a variety of resources creating a unique learning experience that could widen students' mathematical perceptions. In the lesson, the students were given the opportunity to converse with elders and livelihood workers and be exposed to the livelihood activities in their community. Additionally, instructional materials used were all locally-available materials that are familiar to students. Strengthening link among students, school, members of the community and community itself; (2) Outdoor learning. Activities situated outside classroom let students explore mathematics within their immediate environment and lived experiences. Also, exposing them to traditional games, which they use to play before and those introduced by the elders, reminded them of their traditional games, appreciating its beauty and effects in learning mathematics; (3) Collaborative learning. According to Vygotsky (1978) learning is a social process. Collaborative activities require teamwork enabling them to work in groups, share their ideas, and reflect from gathered facts, opinions, beliefs and others point of views. Additionally, the NCTM standards suggest pedagogical practices that includes the use of inquiry-based and cooperative learning, which are aspects of culturally responsive teaching; (4) Lastly, Problem-based. Letting students create and solve problems on their own is one way of acknowledging and recognizing students' mathematical thinking.

Effects of the Lessons Integrated with Cultural Practices

To determine the effects of the lessons to students' understanding of the concepts, a researcher-made pretest and posttest were administered to students before and after the implementation of the lessons together with the Mathematics Interest Inventory Checklist to measure the interest towards Mathematics.

Conceptual Understanding.

Conceptual understanding was operationally defined as the students' level of understanding of the mathematical concepts guided by the competencies set by the curriculum. This was also measured through the proficiency level of the students after exposure to culturally relevant activities. Table 3 shows the performance of Grade-7 students in the pretest and posttest.

Table 3. Performance of the Grade 7 Students in the Pretest and Posttest on Understanding of Geometric Concepts

No.	Learning Competency	No. of items	Mean Score		Mean Gain	Proficiency Level (%)		Gain (%)	Computed t
			Pre Test	Post Test		Pre Test	Posttest		
1	represents point, line and plane using concrete and pictorial models. (M7GE-IIIa-1)	7	2.35	5.00	2.65	33.51	71.43	37.92	**8.96**
2	illustrates subsets of a line. (M7GE-IIIa-2)	6	2.22	4.85	2.63	36.97	80.91	43.94	**11.26**
3	derives relationships of geometric figures using measurements and by inductive reasoning; supplementary angles, complementary angles, congruent angles, vertical angles, adjacent angles, linear pairs, perpendicular lines, and parallel lines. (M7GE-IIIb-1)	14	3.02	5.91	2.89	21.56	42.21	20.65	**6 .90**
4	derives relationships among angles formed by parallel lines cut by a transversal using measurement and by inductive reasoning. (M7GE-IIIc-1)	13	2.87	5.51	2.64	22.10	42.38	20.28	**7.06**
Overall		**40**	**10.45**	**21.18**	**10.81**	**28.53**	**59.23**	**30.70**	**19.97**

2.67 Critical Value;0.05 level of Significance

As reflected in table 3, competency no. 3 got the highest mean gain of 2.89, but also got the lowest proficiency level of 42.21%. This means that the performance of the students in terms of deriving relationship between geometrical concepts was still found very low even after exposure to culturally responsive teaching. On the other hand, competencies 1 and 2, both have high proficiency percentages and mean gains, indicating that their performance for the said competencies was enhanced. Overall, the difference between the performance of the students for each competency was found highly significant through t-test with a general computed t-value of 19.97 and critical value of 2.67 at 0.05 level of significance. Correspondingly, table 4 shows the performance of Grade-10 students in the pretest and posttest.

Table 4. Performance of the Grade 10 Students in the Pretest and Posttest on Understanding of Probability Concepts

No.	Learning Competency	No. of items	Mean Score		Mean Gain	Proficiency level (%)		Gain (%)	Computed t
			Pre Test	Post Test		Pre Test	Post Test		
1	illustrates the permutation of objects.	4	2.29	3.54	1.25	57.21	88.46	31.25	**8.33**
2	illustrates the combination of objects. differentiates permutation from combination of n objects taken r at a time.	3	2.02	2.87	0.85	67.31	95.51	28.2	**7.61**
3	solves problems involving permutations and combinations.	15	5.60	8.19	2.59	37.31	54.62	17.31	**7.04**
4	Illustrates events; and union and intersection of events. illustrates the probability of a union of two events. finds the probability of A∪B.	11	3.25	5.48	2.23	29.55	49.83	20.28	**8.83**
5	Solves problems involving probability	7	2.90	4.58	1.68	41.48	65.38	23.9	**6.10**
Overall		**40**	**16.06**	**24.65**	**8.59**	**46.57**	**70.76**	**24.19**	**13.00**

2.04 Critical Value; 0.05 Level of Significance

Table 4 reveals that the mean scores of the students for each competency was enhanced with a total mean gain of 8. 59 and a proficiency increase of 24.19%. The result for each competency was also tested using t-test for paired or dependent sample and were all found highly significant with a total computed t-value of 13.00 at 0.05 level of significance. To clearly visualize the result, the proficiency level of both group of students, Grade-7 and Grade-10, in each competency is shown in the graphs below.

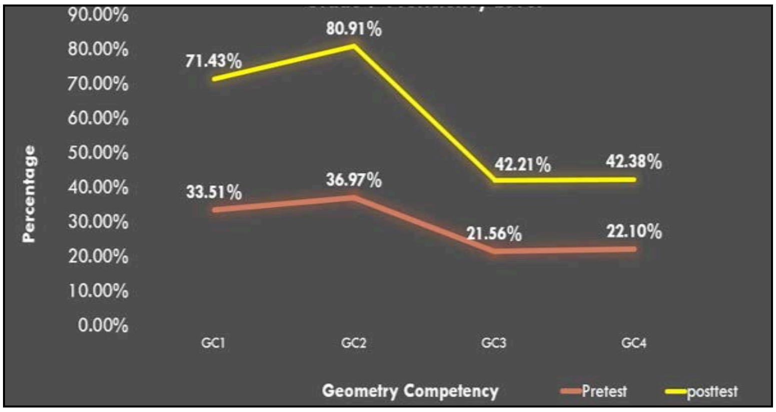

Figure 8. Grade-7 Proficiency Level

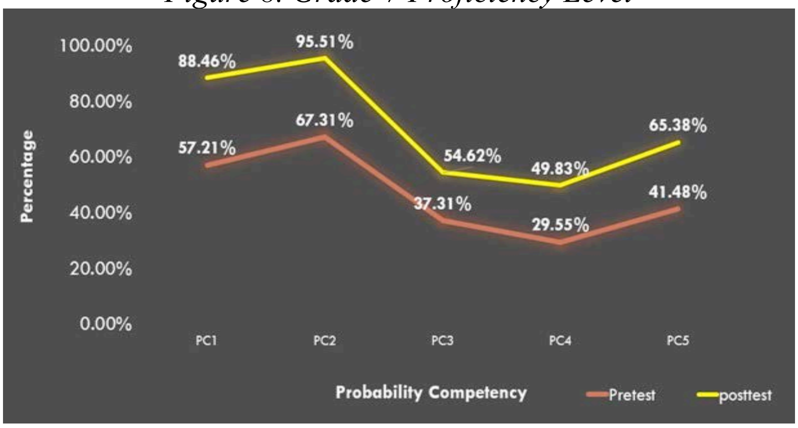

Figure 9. Grade10 Proficiency Level

Both graphs show that there is an increase in the proficiency level of the students after being taught with culturally-relevant lessons. It clearly shows that the first two competencies in Geometry (GC1=71.43%, GC2=80.91%) and in Probability (PC1=88.46%, PC2=95.51%), got higher percentages as compared to other competencies. This implies that the students were able to illustrate, identify, differentiate mathematical concepts and solve simple math algorithms. However, it is visible that the remaining competencies for both subjects got lower percentages even after the implementation of the lesson. This connotes that the students still find difficulty in solving word problems and in deriving relationships between mathematical concepts through inductive reasoning. According to Mayer (1985) many students are struggling to translate problems in their own understanding and represent it mathematically. This suggests that the students still need enhancements for these competencies. But overall, the difference between the conceptual understanding of the students before and after exposure to culture-related activities was found highly significant.

Interest towards Mathematics

The students' interest towards mathematics was determined through the Mathematics Interest Inventory Checklist that was modified from the works of Dela Rosa (2000). It was made based on the observable behaviors of the students towards the subject. This is composed of 15 statements which were classified into three; items 1 to 5 are under the category, enjoyment in Math; items 6 to 12 are under the appeal of Math Activities; and items 13 to 15 are under the appreciation of the importance of Math in real life. The table below shows the result of the mathematics interest inventory checklist of Grade-7 and Grade-10 students.

Table 5. Interest towards Mathematics of Grades 7 and 10 Students.

Interest	Grade -7				Grade-10			
Category	Mean	Before	Mean	After	Mean	Before	Mean	After
Enjoyment in Math	2.80	SI	3.57	I	3.00	SI	4.14	I
Appeal of Math Activities	2.82	SI	3.62	I	2.96	SI	3.88	I
Math in Real-life	3.08	SI	3.45	I	2.92	SI	3.77	I
Over-all	2.90	SI	3.64	I	2.96	SI	3.93	I

Legend: SI-Somehow Interested, I- Interested

Table 5 highlights that the interest of both group of students had shifted from "somehow interested" to "interested". Grade-7 students got an over-all mean score of 3.64 with a descriptive rating of "interested". Likewise, Grade 10 students also got a descriptive rating of "Interested" with a total mean score of 3.93. Both demonstrated a change in their interest level which means that integration of cultural practices in teaching mathematics indeed stimulates students' interest towards mathematics. It is also worthwhile to note that "appeal of math activities" in Grade-7 and "enjoyment in math" in Grade-10 got the highest mean scores of 3.62 and 4.14, respectively. Thus, the students were actively involved in the activities coupled with their cultural practices making them personally connected to the lesson. Similarly, culturally relevant activities promoted a sense of belongingness among the students, which triggered their motivation and confidence to participate well in the discussion as stated by Villegas (2007).

Conclusion

Identifying cultural practices that can be integrated into mathematics instruction is not as easy as it sounds. This requires extra effort, patience and understanding from the teachers just to become culturally responsive in instruction. The cultural practices that were found mathematical were along traditional games and livelihood activities. These practices prove that mathematics has indeed cultural relevance. Along traditional games, some of the mechanics of *turubigan*, *piko't-bado*, *ikus-kino*, *siklot*, Indian game, *siripaan binungan*, and *dulay-dulay* were found mathematical in nature. For example, the selection of groupmates, arrangement of the member, flipping of *binungan* or coconut shell, choosing the *taya* or “It” were all displaying mathematical concepts like permutation, combination and probability. Correspondingly, the practices along livelihood activities that were found mathematical are in terms of *sinamay* weaving, *banig* or mat, and *abaniko* or fan making, crop and *copra* production and carpentry. Specifically, the placement or arrangement of the materials in *sinamay* weaving, planting of crops in parallel rows, choosing of the colors and designs in *sinamay* weaving, *banig* and *abaniko* are all displaying substantial concepts that were integrated into mathematics instruction. Overall, culturally relevant instructions provided the students a unique learning experience that has deepened their understanding of the mathematical concepts and boosted their interest towards mathematics.

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