

SELECTIVE USE OF CULTURALLY-BASED MATHEMATICS IN A PRESERVICE  
TEACHERS COURSE AT THE COLLEGE OF MICRONESIA-FSM CHUUK CAMPUS

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## **ABSTRACT**

This qualitative case study explored the journey of six preservice teachers about using cultural practices and activities in teaching mathematics lessons by engaging them in culturally based mathematics lessons. Specifically, this research investigated the initial perceptions and the changes to participants' initial perceptions, if any, based on their own reflections of their experiences about the use of carefully selected cultural practices and activities in teaching mathematics lessons required in the College of Micronesia-FSM teacher preparatory course MS 210/Ed.

Additionally, the study examined the perception of the participants about the impact of these lessons taught using cultural practices and activities in their learning of mathematics and their perceptions on the implications of their experiences upon their future teaching practices.

Guided from a constructivist view and following two of the models suggested by Averill, et al. (2009) to illustrate how the culture of learners can be integrated in teaching formal classroom mathematics, data were collected from the participants through pre-survey questionnaires, journals, narrative story, post survey questionnaires, and field notes from classroom observations and informal interviews. Data gathered were analyzed and findings were organized around key themes that emerged throughout the research study.

Findings of the study suggested 1) the significance of direct, hands-on experience in developing as well as effecting change in perceptions about culturally based mathematics, 2) that using culturally relevant lessons is an effective way of learning

mathematics, 3) that using culture is an effective foundation for teaching, and 4) that there are challenges and difficulties in implementing culturally based mathematics in the classroom.

Relevant to the above findings and its implications for teacher preparation teaching practices as well as culturally based mathematics research, this study recommends 1) further research on teacher preparation courses to providing preservice teachers more culturally based mathematics lessons, 2) study the impact on the academic achievement of preservice teachers, 3) the development of culturally based mathematics training programs for preservice and inservice teachers, and 3) the creation of a Culture Resource Center where elders will be able to contribute inputs about culture, knowledge and experience that will be preserved for all students learning.

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## **CHAPTER 1. INTRODUCTION**

The College of Micronesia-FSM (COM-FSM) is the only institution of higher education in the Federated States of Micronesia (FSM). It is a five-campus institution with the COM-FSM National Campus and COM-FSM Pohnpei State Campus located at Pohnpei, COM-FSM Kosrae Campus in the State of Kosrae, FSM Fisheries and Maritime Institute and COM-FSM Yap Campus in the State of Yap, and COM-FSM Chuuk Campus in the State of Chuuk. The Accrediting Commission for Community and Junior Colleges (ACCJC) of the Western Association of Schools and Colleges (WASC), an institution that is recognized by the Commission on Recognition of Post-Secondary Accreditation as well as the U.S. Department of Education is the accrediting agency for the College of Micronesia-FSM.

The College of Micronesia-FSM Chuuk Campus is located in the Island of Weno in the State of Chuuk. It caters to approximately 400 students. A 2-year associate degree in teacher education is the only degree program offered by the college with the rest of the programs being certificate of achievement programs in various fields like vocational, business and bookkeeping. The Associate of Arts in Pre-teacher Preparation-Elementary is a degree program designed to "provide students with courses rich in content, theoretical foundations and practical experiences (methodology)" (COM-FSM Catalog 2012 -2013 p. 58), that will address the needs of pre-service candidates who may go straight to teaching or further their education in other institutions outside of FSM, as well as in-service teachers who are presently teaching who do not have an education degree. The program is designed to provide students in the degree program with the essential skills and knowledge to be able to teach efficiently in a culturally relevant manner.

There are only two math courses offered by the program: MS 100 - College Algebra -which is a general education core requirement and MS/ED 210 - Math for Teachers -which is a major requirement of the Associate of Arts in Pre-teacher Preparation-Elementary. Aside from ED 210 - Introduction to Professional Teaching, MS/Ed - 210 - Math for Teacher - is the only other course that is offered in the program that prepares the students to teach mathematics in elementary school. It is a 3-credit course that deals with the mathematical skills and concepts that are usually taught in the elementary schools in the State of Chuuk. Although the course outline deals mostly with mathematics content and does not specifically require it, methods and strategies are incorporated in teaching the contents.

MS 210/Ed - Math for Elementary Teachers, being the only content and method mathematics course in COM-FSM, Chuuk Campus, undertakes the task of preparing pre-service teachers by providing the necessary content and methodology to be able to meet the challenges of teaching effectively in a manner that is significant to students and their culture.

This serves as a great challenge for the course instructor considering that education is changing rapidly, being shaped as it is by socio-cultural, political, economic and technological influences. Because of its geographic location, Chuukese students that attend the college, come with different life experiences, diverse social, cultural, political, economic, and technological background.

Providing culturally relevant curriculum and effective instructional pedagogy like teaching culturally based mathematics may well be one way of meeting these challenges. As noted by Varian (2008), there is a growing body of research that demonstrates that a

culturally relevant instructional approach is effective with such students. For the instruction to be effective, teachers need to understand the connection between culture and pedagogy (Hayes 2010). This, according to Lopez-Carrasquillo (2006), involves a delicate balance between the curriculum mandate, the teacher's own interests, and the students' needs.

In particular, emerging definitions in mathematics education support the need to improve learning experiences through the use of culturally-responsive teaching strategies that could be organized in order to actualize the balance between accommodating the individual student's culture, needs and interests and supporting the attainment of appropriate mathematics learning goals (Fulton, 2009).

As Kana'iaupuni (2007) very simply put it, culture refers to shared ways of being, knowing, and doing. Culture-based education is the grounding of instruction and student learning in these ways, including the values, norms, knowledge, beliefs, practices, experiences, and language that are the foundation of a [indigenous] culture. Because U.S. society typically views schools through a Western lens—where Western culture is the norm—what many do not recognize is that all educational systems and institutions are culture-based. Hence, the term is conventionally used to refer to “other” cultures, and in this case indigenous cultures.

In many countries, including the Federated States of Micronesia (FSM), mathematics teachers such as the researcher, find means to infuse culture-based instruction to their students in particular to would-be teachers. However, much of the instructional materials available are situated in other cultures, especially those in the southern parts of the United States.

Enthused by the National Science Foundation funded program *Mathematics and Culture Micronesia: Integrating Societal Experiences* (MACIMISE) and the scarcity of instructional materials, as well as research literature situated in the setting of COM-FSM, Chuuk Campus, I was motivated to conduct this study that will assess pre-service mathematics teachers' perceptions and growth in using culturally-based teaching of mathematics. The research participants' reflections about their experiences can be an important source of insights into the effectiveness of the infusion of culture-based pedagogy into the mainstream of mathematics instruction (Liu, 2010).

### **Purpose of the Study**

The purpose of this study is to determine the pre-service teachers' perceptions and growth in using cultural practices and activities in teaching mathematics lessons by engaging MS/Ed 210 - Math for Elementary Teachers - in the College of Micronesia-Federated States of Micronesia (COM/FSM), Chuuk Campus, in culturally-based mathematics lessons. Specifically, this research aims to assess the change in the perceptions of the pre-service teachers about using cultural practices and activities in teaching mathematics lessons based on their own experience in the COM/FSM teacher prep course MS 210/Ed - Math for Elementary Teachers.

The research study aims to assess the initial perception and changes in the perceptions, if any, of the pre-service teachers about using cultural practices and activities in teaching mathematics lessons based on their own experience in the COM/FSM course MS 210/Ed - Math for Elementary Teachers. Furthermore, it endeavors to evaluate their perception on the impact of these lessons taught using cultural activities and practices in



their own learning of mathematics and their perception on the impact of mathematics in the learning of mathematics and their future professions as teachers.

To determine such, the research study seeks to answer the following questions.

1. What are the pre-service teachers' initial perceptions about the use of cultural practices and activities in teaching mathematics in the classroom?
2. What are the changes in perception of the pre-service teachers initial perceptions on the use of cultural practices and activities in teaching mathematics if any?
3. What are the impacts of using cultural practices and activities in teaching mathematics in the classroom in the pre-service teachers' learning of mathematics?
4. What are the participants' perceptions about the implication of using cultural practices and activities in teaching mathematics in the classroom upon their future teaching practices?

### **Theoretical Framework**

The cognitive theory is involved when changes in behavior are seen as indirect rather than direct outcomes of learning. Observable behavior is mediated and controlled by such mental activities as the acquisition, organization and application of knowledge about the world; by the development of skills that allows the encoding, storing and retrieval of information; by people's motivation; their perception of what a task requires of them; and their perception of their likelihood of success. Consequently, students are seen as active in the construction of knowledge and the development of skills, leading to the conclusion that learning is a generative process under the control of the learner.

Moreover, a basic premise of the constructivist paradigm is that the learner comes to the task with prior knowledge and understanding. When a new or different concept is presented, the learner builds on and/or modifies pre-existing mental models to form new constructs. Piaget labels this context of inconsistency as “Disequilibrium”, where the learner is striving to assimilate or accommodate this new information (Wadsworth, 1971). It is the process of individuals constructing their own understanding through interactions with the environment that defines constructivism (McInerney & McInerney, 1994). Another premise of the constructivist paradigm is that learning occurs within a social context and that it is affected by the interactions learners have with others, what Vygotsky's calls the “zone of proximal development” (Ashman & Conway, 1997).

Constructivism has specific implications for pedagogy. Firstly, it asks students to cope with very complex situations where the cognitive load is high. Perkins (1991) explains that cognitive instruction aims to confront the learner with situations that make the inherent inconsistencies in the learners' native model plain and challenge the learners either to construct better models or at least to ponder the merits of the alternative models presented by the teacher. Therefore this conflicted path has very high cognitive demands. Complex situations are most effectively represented in authentic tasks, that is, those that have real-world relevance and utility; are problem based and or related to community issues; draw on knowledge from across the curriculum; provide appropriate levels of complexity; and allow students to select appropriate levels of difficulty or involvement (Jonassen, 1991).

Constructivist pedagogy is learner - centered. The focus is on active exploration, where the learner is developing the necessary skills to become autonomous and where the

teacher approaches learners within their 'zone of proximal development' by providing just enough help or guidance (Ashman & Conway, 1997). The difficulty presented to learners in such a constructivist learning setting, are two-fold. They are faced with the challenge of discovering the concept for themselves as well as learning how to learn, developing and implementing strategies for independent thinkers and learners.

Lastly, constructivist pedagogy emphasizes how the learner goes about constructing knowledge rather than the end product of that construction (Jonassen, 1991). The emphasis is on the process of learning, on how the individual acquires the skills, strategies and resources needed to perform learning tasks effectively as well as the ability to know when and how to use particular learning strategies. McInerney and McInerney (1994) refer to this as “metacognition”, the process of knowing how to monitor one's cognitive resources and knowing how one learns.

In the same vein, a cognitive apprenticeship is much like a trade apprenticeship, with learning that occurs as experts and novices interact socially while focused on completing a task; the focus, as implied in the name, is on developing cognitive skills through participating in authentic learning experiences. Collins et al. (1989) succinctly define it as “learning-through-guided-experience on cognitive and metacognitive, rather than physical, skills and processes.” Core to cognitive apprenticeship as a method of learning is the concept of situatedness and the concept of legitimate peripheral participation, both described by Lave and Wenger (1991).

Situated learning occurs through active participation in an authentic setting, founded on the belief that this engagement fosters relevant, transferable learning much more than traditional information-dissemination methods of learning. However, it is more

than just learning by doing; situated learning requires a deeper embedding within an authentic context. Human actions of any nature are socially situated, affected by cultural, historical, and institutional factors (Wertsch, 1998). This situatedness is a key component of the learning environment and thus needs to be considered in a cognitive apprenticeship.

### **Significance of the Study**

Pre-service teachers who are registered in math preparation courses with prior ideas of their abilities in mathematics (knowledge) and their skills in teaching mathematics (pedagogy) are the focus of the study. Their ideas are most often built on past experiences with the subject as well as other method courses. These past experiences with mathematics course and the way they were taught these courses have implications on their own motivation and ability to teach mathematics. Those who have learned mathematics using procedural methods and algorithms are bound to teach the same way when they become teachers (Ogden, 2012).

Poor quality of learner outcomes is one of the most pressing issues that the Chuuk State Department of Education needs to address. One reason, as implied in Levin's (2010) report, is poorly trained teachers that do not show internationally accepted standard of best practices. Teachers must learn to teach and the college (COM-FSM) should serve as a training ground for teacher preparation through a culturally responsive curriculum. (Cholymay, 2013)

This study has implications for preparing pre-service teachers to be culturally responsive. In order for teachers to use cultural practices and activities to teach mathematics, they should be exposed to such practices and activities as early as possible

in their pre-service education. Allowing them to experience learning mathematics through the use of their own cultural practices and activities may possibly be a starting point of their teacher training moving towards becoming effective teachers in a culturally-responsive curriculum. The experience provided to the pre-service teachers in MS 210/Ed - Math for Elementary Teachers may have impact to their own person, to this teacher preparation course, and in developing future pre-service as well as in-service teacher training program.

If the perceptions of the pre-service teachers undergoing lessons that are taught mathematics using cultural practices and activities are positive, it will also have a positive impact on their learning as well as teaching of mathematics. They will acquire confidence in their ability to teach mathematics in way that is meaningful to their student. Furthermore, they will be motivated to teach mathematics in elementary classrooms using cultural practices and activities.

The study will also mandate the need to change the delivery of MS 210/Ed - Math for Elementary Teachers - course content towards culturally based pedagogy rather than textbook driven method of teaching.

The study may also provide a framework for developing a culturally based Teacher Training Program for pre-service and in-service teachers that is aimed towards improving the teaching of mathematics in the classroom.

This study could potentially motivate other teachers in the college to produce research about using cultural practices and activities in teaching their respective course and field of specialization.

## **Scope and Limitations**

The focus of this study is on the perception of pre-service teachers about using selected cultural practice and activities to teach mathematics for the course MS/Ed 210 - Math for Elementary Teachers - and its' impact upon their own learning of the mathematics content of the course and their future teaching of mathematics in elementary. MS/Ed - 210 is a pre-service teachers' course offered in the College of Micronesia - FSM, Chuuk Campus, designed to equip pre-service students the necessary mathematics content and methods needed to teach mathematics in elementary schools effectively.

The study is limited to six students who are registered in the course for Summer 2013. The students were purposely selected, invited, and agreed to participate in the study.

Another limitation of this study is its focus on perceptions of the participants on the mathematics lesson taught to them using cultural practices activities and practices. I used the required textbook and different references as well as various methods and strategies in teaching to accomplish the course-set student learning objectives. Beyond the scope of this study are the students' perceptions about the other methods and strategies used and culturally based lessons as well as the comparison between both.

Finally, the study is limited to Chuukese cultural practices and activities and does not include cultural practices and/or comparison of the other states of FSM where other College of Micronesia state campuses are located.

## **CHAPTER 2. REVIEW OF RELATED LITERATURE**

"Why should a student need to learn all these things? Wouldn't it be more worthwhile to focus on topics that were of more relevance and importance to Micronesians?" (Suhm, 1996, p. 149)

Effective math teaching in any setting should build upon where the children are and must evolve with the children as they cultivate mathematical concepts in relevant and meaningful situations which are structured for them in such a way that broaden mathematical ideas developed (Graham, 1982). Many advocates of ethnomathematics believe that the infusion of cultural practices and activities in the curriculum as well as teacher's pedagogy can provide relevant and meaningful experiences to students of mathematics.

### **Culturally Based Curriculum in FSM Education**

Educators, education leaders, college administrators, and government leaders in the Federated States of Micronesia share the view concerning the infusion of cultural activities in the curriculum. Cholymay, one time a co-teacher in the College of Micronesia-FSM, Chuuk Campus, called for "Chuukese people to engage in a national dialogue on educational reform, to document Chuukese culture, and to teach our values, knowledge and practices in our schools" and "to bring together the divergent yet representative voices of the Chuuk State Community in a quest to envision a culturally responsive educational system" for Chuukese people (Cholymay, 2013, p. 1).

Cholymay investigated the incorporation of Chuukese values, practices, and knowledge in the educational practice in Chuuk, and found that Chuukese culture is considered as the foundation of learning and the incorporation of Chuukese cultural practices and activities in the education curriculum will be a way to help better understand school success (Cholymay, 2103). This is consistent with the mission vision

of the College of Micronesia-FSM and the objective of the education program of the college.

Furthermore, teachers and administrators of the college, as well as the nation's education and government leaders recognize this as one of the central functions of COM-FSM. Recognizing that political leaders of the nation have an influence in the setting of goals and priorities of COM-FSM, Rechebei (2013) conducted a case study on the perception of political leaders of FSM on the role of COM-FSM. Major findings of her study indicated that the political leaders perceived that teacher training is a very important role of the college, but she seemed to be skeptical and uncertain about the teaching of local cultural practices and activities as well as local language. Nevertheless, the study indicates the association of the pedagogical aspect of language and culture with teacher training (Rechebei, 2013).

Suhm (1996) investigated the role of education ascribed to COM-FSM. The quantitative study identified the role of the college through the roles attributed to other colleges, and he supplemented it with interviews from the participants to verify whether there are additional roles not contained in the reviewed literature and available documents. Upon establishing the roles of the college, college staff (teachers, office staff, and administrators) and students were asked to rank the identified roles. The study shows that among the most valued roles of the college as perceived by the college staff is to promote the learning of local culture and to train school teachers to improve the whole educational system and implied that some teachers attempted to modify their method of teaching and textbook concept application to be more relevant and significant to Micronesians. He narrates...



Some of the faculty I talked to was critical of the College's apparent leaning towards American education. An example cited given was professors, who rely heavily on American textbooks and curriculum that stress American examples and content, and then turn around and fail a big numbers of students that don't meet their standards. The question asked by more than one person interviewed was, "Why should a student need to learn all these things. Wouldn't it be more worthwhile to focus on topics that were of more relevance and importance to Micronesians? (Suhm, 1996, p. 149)

The infusion of cultural practices and activities with required content especially in the pre-service teachers' courses could be a means to train effective teachers equipped with cultural relevant pedagogy. The result of this research study may provide a primer in the development of a model that will train pre-service teachers and equip them with culturally relevant pedagogy and fulfill the perceived role of the COM-FSM.

### **Culturally Based Mathematics Curriculum**

#### ***Ethnomathematics and Culture***

Hammond (2000) offers a simplified definition of ethnomathematics referring to "the study of mathematics in relation to culture" (Hammond, 2000, p. 8). The simplified definition was formed considering mathematics being the root word and ethno as a prefix from the word ethnography. Furthermore, culture pertains to "traditions and customs, transmitted through learning, that governs the beliefs and behavior of the people exposed to them. Children learn these traditions by growing up in a particular society" (Kotak, 1994, as quoted by Hammond).

This definition reflects the relation of culture and mathematics and permits the study of the integration of mathematics and culture in formal classroom setting; mathematics being viewed as formal classroom mathematics and often times referred to as western mathematics. As such, these definitions of ethnomathematics and culture have been adopted for the purpose of this study.

### ***Possibilities of Integrating Culturally Based Mathematics***

Advocates of ethnomathematics believe on the relevance of culture in teaching and learning of mathematics. This advocacy leads to changes in the teaching of mathematics that acknowledge the important role of culture in mathematics education and abandoning a long-time perception that mathematics is culture free (Presmeg, 2005).

Among the facets of the role of culture in mathematics education being studied is the infusion of cultural practices and activities in mathematics curriculum and formal academic mathematics. Although a lot of mathematics teachers have been convinced of the possible results of integrating culture into the curriculum, questions as to how they should go about it remains (Dickenson-Jones, 2006).

Rowland and Carson (2002) suggested four possibilities of how ethnomathematics "might stand in relation to formal academic mathematics" namely: "ethnomathematics should replace academic mathematics in the curriculum, ethnomathematics should be involved in mathematics curriculum as a supplement so that students can appreciate the nature of human cultures, ethnomathematics should be used as a springboard for academic mathematics, ethnomathematics should be taken into account when preparing learning situations" (Roland and Carson, 2002 p. 80). However, Adam and Barton (2003) claims that it is not the intention of ethnomathematics to replace formal academic mathematics but supports a curriculum where both formal academic mathematics and mathematical ideas of different cultures are similarly regarded (Adam and Barton, 2003).

### ***Reasons for Integrating Culturally Based Mathematics***

Another effort to conceptualize ethnomathematics' infusion into the curriculum is

Adam's classifying ethnomathematics curriculum in terms of the various reasons of why ethnomathematics should be included in mathematics curriculum (Dickenson-Jones, 2006).

Adam identified five reasons for integrating ethnomathematics in school curriculum from literature reviews on ethnomathematics.

First, ethnomathematics curriculum seeks to make mathematics meaningful by presenting mathematics as a response to the needs of the students. Mathematical concepts delivered in the classroom will be more meaningful to the learners because they can connect it to practices and activities that are well known to them (Adam, Alangui, and Barton, 2003). This is based on the concept that if learners identify themselves with the mathematics they are learning through their culture infused in the curriculum, they will recognize the relevance of learning the mathematics (Bishop, 1988).

Secondly, ethnomathematics curriculum initiates the inclusion of particular cultural practice and activity that is different from the classroom mathematics.

The third reason offered is an ethnomathematics curriculum builds upon prior knowledge and experiences of learners to connect classroom mathematics. Mathematical ideas from the learner's own culture integrated with classroom mathematics allow students to appreciate the link between the two (Adam, 2004; Begg, 2001).

The fourth, ethnomathematics curriculum generates adjustment in the way that mathematics is delivered in the classroom to fit the learner's cultural experiences and the environment from which these experiences occur (Adam, 2004; Bishop, 1998).

The fifth, ethnomathematics curriculum substantiates the mathematical ideas imbedded in student's culture when they are integrated with classroom mathematics.

Learners participation in their own cultural practices and activities will motivate them to cultivate their understanding about the development of mathematical ideas and "how they are built into systems, how they are formulated, and how they are then applied in various ways within the culture" (Adam, 2004, p. 52).

The study conducted by Shehenaz Adam from which these reasons were identified was to investigate the implementation of ethnomathematics unit in a mathematics classroom in the Maldives. The study was based on the approach that ethnomathematics curriculum is an integration of the culture of the learner with formal academic mathematics. The curriculum model used an ethnomathematical unit of work on measurement and was implemented by grade 5 teachers at two primary schools.

Findings indicated that participants were motivated and preferred to learn mathematics the way that they learned using the curriculum model. These allowed the students to connect classroom mathematics with real-life activities, and assisted them in understanding formal academic mathematics. Furthermore the findings suggested that ethnomathematics curriculum could also be used to introduce formal academic mathematics in a way that it was well understood thus becoming more significant to learners (Adam, 2002).

### ***Transformation of Culture in Culturally Based Mathematics***

In a descriptive and comparative analysis study of written mathematics curriculum text, Amelia Dickenson-Jones (2006) noted the difference between the cultural practices and activities of indigenous people and how they are represented in the textbook. The study investigated how these cultural practices and activities change in from their original form and purpose when integrated into the mathematics curriculum

text. Findings of the study show that cultural practices and activities change from their original form and purpose when integrated into curriculum and "transformation occurs when western classroom mathematics intersects with the cultural practices of indigenous groups and may involve many issues that are related to preserving aspects of two different systems of knowledge" (Dickenson-Jones, 2006, p. 35). The study identified five modes of transformation that occurs when infusing culture into formal mathematics.

First mode is disjunction that occurs when the students are not required any engagement with the actual cultural practice integrated in the curriculum and used purely as a stepping stone to understanding course content of formal classroom mathematics (Dickenson-Jones, 2006).

Second mode of transformation is translation. This translation occurs when students engaged in some parts of the cultural practice that is needed to understand a particular concept of formal classroom mathematics (Dickenson-Jones, 2006).

The third mode is integration. In this mode of transformation, students' engagement of the cultural practice is for the purpose of theoretical comparison between the cultural practice and formal classroom mathematics. This occurs often in instances when students engaged in cultural measurement for the purpose of comparing it to counting and measurement of formal classroom curriculum (Dickenson-Jones, 2006).

Correlation, the fourth mode describes engagement of both the cultural practices and the formal academic mathematics for the purpose of attaining concrete comparison between the two. Students acquire knowledge and understanding through actual experiences of both cultural mathematics and formal classroom mathematics. This is commonly seen in the teaching of counting numbers (Dickenson-Jones, 2006).

The fifth transformation resulting in the study is the union that entails students to engage in formal classroom mathematics activity that is very similar to cultural practices of the learners (Dickenson-Jones, 2006).

### ***Models for Integrating Culturally Based Mathematics***

The study of Averill et al. (2009), provided three models to illustrate how cultural practices and activities of learners can be integrated in teaching formal classroom mathematics. Two of these models were developed from their attempt to offer pre-service teachers culturally responsive teaching experiences that they can use in their own teaching.

The Components Model allows the infusion of as many types of cultural concept as possible in a carefully designed and coherent approach. The model permits the inclusion of an extensive diverse cultural practices and activities of learners in teaching formal classroom mathematics curriculum (Averill et al., 2009).

The Holistic Model is thematic in its approach. The abundance of mathematics from the chosen cultural practice or activity provides the basis of development of learners understanding of formal classroom mathematics. In essence, this is different from the components model; in a way that the cultural practices integrated was based on the formal mathematics that will be taught. On the other hand the holistic model, mathematics identified with the culture was the basis of what concept of classroom mathematics should be taught (Averill et al., 2009).

The Principles Model takes into account three different principles that should be taken into account when integrating cultural activities and practices in classroom mathematics. The principles includes soliciting the valuable inputs of cultural experts

(*partnership*), respecting and preserving and fostering cultural practices and activities (*protection*), and ascertaining learners access to engage in cultural activities by the members of community concerned (*participation*) (Averill et al., 2009).

### ***Relevance to this Study***

Although the scope of this research does not include the analysis of how culture was integrated into the formal classroom mathematics, the reasons for integrating culture, and the model used in integrating culture in teaching of the content of MS/Ed 210 - Math for Elementary teachers - they have in many ways influenced the development of the cultural activities and lessons taught in the classroom.

Working on the possibilities that "ethnomathematics should be used as a springboard for academic mathematics, ethnomathematics should be taken into account when preparing learning situations" (Roland and Carson, 2002 p 80) and based on modes transformation, correlation, integration, as reasons and engagement for integrating selected cultural activities (Dickenson-Jones, 2006), a holistic model using Chuukese Torch Fishing and components model activity using Traditional Lei Making, Chuukese Counting Numbers, and Coconut Counting was carefully designed for pre-service students of MS/Ed 210, with inputs from the elders of the community who are considered cultural experts in Chuuk (Averill et al., 2009).

### **Cultural Practices and Activities in Formal Classroom Mathematics**

Studies integrating cultural practices and activities to classroom instruction or curriculum showed positive evidence of long-term benefits to the learners of mathematics such as increasing their comprehension of mathematics and connecting mathematics with their everyday life (Bishop, 1998). Teaching school mathematics curriculum helps to

enhance student's learning and development by integrating cultural practices and activities unique to the learners, and provides means to maintain their identity at the same time succeeding academically (Rosa and Orey, 2011).

Wong (2003), studied adding cultural values to mathematics instruction by developing and using NE x ME matrix, where NE refers to cultural values (called National Education in Singapore) and ME refers to mathematics education, to help teachers conceptualize the integration the infusion of cultural values with formal school mathematics (Wong, 2003).

Another study analyzed how Pacific Island English Language Learners, their classmates and their teacher's analysis of read texts included their values, cultural practices and activities, which use the same home language (Washburn-Repollo, 2011).

Bissley (1975) used both qualitative and quantitative data in her study to investigate the necessity to integrate on appropriate on line cultural practices of diverse Aboriginal adult learner to complement existing mathematics curriculum. Findings indicated that the need to integrate appropriate on-line cultural practices is well supported by educators (Bissley, 1975).

Vomvoridi-Ivanovic (2009) investigated how four bilingual Latina/o pre-service teachers used students' language and knowledge of their cultural practices and activities to facilitate learning of mathematics in an after-school bilingual mathematics program. Findings from the study suggest that pre-service teacher participants' use of language and culture reflected "cultural models for teaching and learning of mathematics which relate to school" (Vomvoridi-Ivanovic, 2009, p. 176).



## **Culturally Based Mathematics and Preservice Teachers**

Educators teach the way they were taught and not the way they were told to teach. This theory of apprenticeship of Lortie (1975) implies that pre-service teachers' future teaching practices are highly affected by how they were taught as students. This further implies that new teachers are unlikely to teach in a way that they did not experience in the classroom as students.

In order for pre-service teachers to embrace and affect teaching practices, they should be allowed to experience such teaching practices in the classroom as students. While it is true that previous life experiences in mathematics classrooms is the foundation for pre-service teachers' deep understanding of how to teach mathematical concepts, it is also the venue where they develop future teaching practices. Thus, providing actual experiences of integrating cultural practices in teaching formal classroom mathematics to pre-service teachers in their preparatory courses in mathematics, their perceptions about these experiences, and the impact on their learning of mathematics and future teaching practice are significant elements to study.

### ***Perceptions and Impact on Practice***

Finch (2008) investigated the perception of pre-service teachers that are taking a course that "is focused in an effort to move class participants from multicultural education theory to instructional practice in P-12 classrooms" (Finch, 2008, p. 98) by integrating cultural practices into the course. The study reveals that, initially, participants believe that they are competent in relating culture and integrating culture in classroom mathematics. Furthermore, completing the course that integrated culture, the participants confirmed better understanding of their own selves and how their experiences with

culturally based instruction influence their teaching and their relationship with their students. Their involvement of pre-service and in-service teachers' in the course changed their perception and increased "... multicultural education and culturally responsive teaching." (Finch, 2008, p. 253)

According to Wills, (2012) who studied a pre-service course "...to assist pre-service teachers to develop proficiency using culturally relevant pedagogy for culturally and linguistic diverse students..." (Wills, 2012, p. 9) showed a different result from that of Finch. Although the study implies that a culturally relevant pedagogy is feasible intervention for the development of pre-service understanding of diverse culture and had a positive influence upon their cultural understanding and support the idea of continuing to offer the course, the study shows that completion of the course had no significant impact upon the pre-service teachers' increase in the level of intercultural understanding.

Moss (2010) study of pre-service teachers' perception about the relevance of culture in teaching formal classroom curriculum and its impact on their teaching by their experiences of their active participation in the real life of their students outside of school, specifically, in this study, was the church. The study showed the impact of their experience in that the pre-service teachers were able to develop culturally relevant teaching strategies that they could use in their classroom. Furthermore, they realized the possibility of providing active learning in the classroom through the knowledge of their students' culture have gained from their church "experience." They saw clear pedagogical implications that pushed them to begin to acknowledge the students' diversity and contemplate how they would incorporate their "cultural ethos and experiences into the classroom learning community" (Moss, 2010, p. 72).

### ***Impact on Learning Mathematics***

Research studies undertaken by Walker (2009), Caron (2006), Molefe (2004), and Moore (2010), revealed that culturally based curriculum as well as use of culturally relevant pedagogy have a positive impact on students learning of mathematics.

Walker (2009) investigated the achievement of the students involved in a summer enrichment camp using culturally relevant curriculum and activities as key predictors. The achievement of students' summer enrichment program under a teacher that implemented a curriculum integrating cultural practices were compared with the achievement of students that went under the same curriculum that is delivered using traditional methods and strategies such as lecture and use of flashcards. The result of the study reflects that the culturally relevant curriculum had a positive impact in the achievement of at risk students. The improvement of at risk students who went through the curriculum integrating cultural practices were more significant compared to those students that went through the traditional methods and strategies.

Another study was conducted by Caron (2006) investigated the impact of culturally relevant curriculum and pedagogy on the learning of twenty-nine students who were considered low achievers. Concepts of functions were taught using culturally relevant curriculum and pedagogy as well as other non-traditional methods and strategies of teaching. The students were made to confront challenging mathematics problem that were relevant to their cultural practices and activities providing them the opportunity for classroom discussion and collaboration with their classmates. Through these classroom experiences, the students "were engaged in their learning and developed positive attitudes about the mathematics classroom" (Caron, 2006, p. 99). The results of the study revealed

students that are low achievers can acquire problem solving skills, that can learn to problem-solve, and can actively be involved in their own learning relative to a culturally relevant curriculum and pedagogy. Caron (2006) claims that the study shows when efforts are made to support students' cultural individuality and recognize the importance of their culture by integrating culture into classroom teaching and through discussions of their different cultural attributes, it will solicit students' engagement from even the most disengaged student.

Molefe (2004) conducted a study to investigate the function of solving culturally relevant problems in the learning of mathematics when the problems are in the chosen language of the learners. The study tried to discover how the students think and the mathematics concept that develop in solving the word problems using the chosen language of the student. The study revealed that struggling students use both English and their chosen language during problem solving activity, and they were able to solve problems using their own strategies that they usually cannot solve before the study. Furthermore, there were indications that culture had influence on their choice of problem solving strategy and were able to use the strategy successfully. "They adjusted these when the need arose and they made reflections. These strategies helped them give their own meaning of the problem" (Molefe, 2004, p. 79).

In another study, Moore (2010) used ex post facto quantitative research design to examine the impact of culturally responsive professional development have students based on their Developmental Scale Score in mathematics. The study used the North Carolina Criterion-Referenced EOG Test to measure performance of student performance being the dependent variable and the culturally responsive program was used as the

independent variable. The study found that after a year of implementation of the culturally responsive pedagogy, the mean score of those who went through the culturally responsive pedagogy was higher by about 15 points than those who were not under the treatment group. This exhibited that the "new behavior learned by the teachers in the treatment group was becoming job embedded and impacting student achievement" (Moore, 2004, p. 79).

### ***Challenges of Implementing Culturally Based Mathematics***

Teaching mathematics by infusing cultural practices and activities may have an impact on the future teaching practices of pre-service teachers as well as their own learning of mathematics but persuading pre-service teacher to embrace the culture integrated curriculum and pedagogy will not be without challenges.

Matthews (2002), in a case study that endeavored to identify and explore the difficulties and the challenges in implementing a model for a culturally relevant teaching of mathematics found two challenges. The study reveals that implementation of culturally relevant model is challenged by teacher's belief that textbook represents the official curriculum and is required as the main source of content teaching and evaluating learning. The teachers view integrating of cultural practices and activities and culturally relevant pedagogy can only be accomplished in the teaching of mathematics when the textbook permits it so.

Another challenge is teachers have to contend with their insufficient "orientations toward the informal and cultural experiences" of their students (Matthews, 2002, p. 139).

Nevertheless, future teachers should be provided various experiences that would challenge the perceptions and beliefs they bring to teacher preparation courses to help

them adapt to the constantly changing educational system, improve teaching skills, and develop highly qualified teachers that are capable of creating learning experiences in the classroom where all students are learning and academically performing at the optimum level of competence.

### **CHAPTER 3. RESEARCH METHODS**

The intent of this research is to provide pre-service students registered in MS/Ed 210 - Math for Elementary Teachers - experience in learning mathematics using cultural practices and activities. Chuukese cultural activities and practices were used to teach selected topics in the required course outline.

Data was collected from 6 participants using: 1) pre-survey questionnaire to determine initial perceptions, 2) journals to solicit reflections for each culture based lesson, 3) post-survey questionnaires to determine changes of initial perceptions and impact to learning of mathematics as well as future teaching profession, 4) narrative story written about students' experiences with all the culture based lessons, and 5) in depth interview to validate and ensure reliability of data presentation and interpretation.

The six participants were chosen through convenience sampling. They had to be registered in the class during the semester that the study is being conducted.

#### **Research Method and Design**

This research project employed qualitative case study design. Hatch describes qualitative study that tries "to capture the perspective that actors use as a basis for their actions in a specific social settings" (Hatch, 2002, p. 7). The object of the study is real people that go through the experience in a real setting to be able to understand their perspective on the said experiences (Hatch, 2002). This study examines the perceptions of pre-service teachers based on their real-life experience of learning mathematics taught using cultural practices and activities in MS/Ed 210 - Math for Elementary Teachers in the classroom.

This study further reflects Hatch's discussion of Yin's and Merriam's work that case study "investigates a contextualized contemporary (as opposed to historical) phenomenon within specified boundaries" (Hatch, 2002, p. 30). Example of these bounded phenomena in education can be "a program, and event, a person, a process, and institution, or a social group" (Merriam, 1988, p. 13, as quoted by Hatch, 2002).

### **Geographic Location**

The research project took place at the College of Micronesia-Federated States of Micronesia (COM-FSM), Chuuk Campus, one of the five campuses of COM-FSM located on the Island of Weno, considered the main island of the State of Chuuk. COM-FSM is the only institution of higher learning available for the students of Chuuk. At present, a two-year Associate of Arts in Pre-teacher Preparation-Elementary is the degree program offered in COM-FSM Chuuk Campus. Some students who pass the COM-FSM Entrance Test (COMET) and do not have the means and do not want to leave their home state, go into the said program regardless of whether they want to be future teachers or not.

### **Informed Consent**

The study was conducted at the College of Micronesia-FSM, Chuuk Campus. A written consent to conduct the study was obtained from the Dean's office, following institutional protocol. The study was presented to and was approved by the dean of the campus before the term that the study began (Appendix B).

A written consent to participate in the research project was also obtained from the pre-service teachers (Appendix A). I met with the selected participants on the first day of instruction and described to them what will occur during the research project, explained



to them what the research is all about, and its importance for their future chosen profession and to the education community as a whole.

### **Participants of the Study**

The participants of this study consisted of six pre-service teachers who took MS 210 - Math for Elementary Teachers during Summer 2013. The said course is required for students taking the Associate Degree in Elementary Education and is offered by the College of Micronesia-Federated States of Micronesia (COM/FSM), Chuuk Campus, every semester as well as during the summer term. It is the only course that prepares them to teach mathematics in elementary schools.

All participants were selected using convenience sampling and were invited to be a part of the study. All participants were 20 years old or older. Of the six participants, two were male and four were female. Although all the participants were Chuukese by birth, they belonged to different regions bringing variations of Chuukese culture. Two of the four female participants are pure Chuukese, one of the female participants, born and raised in Chuuk, has a Filipino father and a Kosrean mother that was born and raised in Chuuk, while the other female participant has an African father and a Chuukese mother. Both of the male participants are pure Chuukese.

The participants were selected during the registration period of the college. After they completed the registration process and were officially registered for the class, which was the only criteria used in the selection process, they were invited to participate in the study and were asked to sign the consent form after which the presurvey questionnaire was given to them and collected prior to the first day of class. The presurvey questionnaire consist of open ended questions designed to acquire qualitative data

regarding the initial perception of the students about culturally based mathematics. The original plan was to interview the participants to determine their initial perceptions, but due to limited time between registration and the first day of class and the expressed hesitance of some of the participants in recorded interviews, I opted for the survey questionnaire.

The participants were required to write journals and a narrative story of their whole experience for the lessons that were taught using cultural practices and activities in class. Guide questions for both journals and narrative story were provided to the participants (Appendix E and F).

A post survey questionnaire was accomplished at the end of the semester subsequent to the participants submitting their narrative story. Interviews were conducted at the faculty offices or the teachers' conference room when available.

***Marivic.*** Marivic is 20 years old and from the Island Wour of the Faichuuk Region. Her father is from the Philippines and her mother is a Kosraean born in the State of Chuuk. She was raised in the main island Weno which is of the northern region. She is not familiar with Chuukese culture. She acquired her little knowledge about the do's and don'ts of the culture when parents directs her to do something because it is in the culture or when she was prohibited to do something because it is against the culture. Although she wants to study political science and dreams to run for congress in the future, she is in the college finishing her Associate Degree in Teacher Preparation because her parents want her to become a teacher. She plans to teach after finishing her degree in the college. She was my student in previous math courses in the college as well her Upward Bound mathematics classes when she was in high school.

***Sylfran.*** Sylfran is 22 years old, recently married, and from Faichuuk Region. Like Marivic, she was also raised in the main island Weno. She learned Chuukese culture such as respect for elders from parents and grandmother. Interestingly, she learned most Chuukese cultural practices and activities while studying in Guam from Chamorro friends and schoolmates. She wants to be a teacher and plans to teach in elementary schools after finishing her Associate Degree in Teacher Preparation at COM-FSM, Chuuk Campus.

***Filimeno.*** Filimeno, who is the oldest among the participants at 40 years old, is from the Island of Hauk in the Northwest Region. The island of Hauk is about eight hours travel by ship from the main Island of Weno. Among all the participants, he is the only one with classroom teaching experience. He taught mathematics at Saramen Chuuk Academy where Aprilyn, one of the participants of this study, was his student. He also taught culture at Xavier High School, and Language Arts at Pentecostal Lighthouse Academy. He came to the college to finish his Associate Degree in Teacher Preparation and plans to go back to his island to teach in elementary schools.

***Chonfan.*** Chonfan is 30 years old, married and from the Island of Weito in the Northwest Region. He finished his elementary school here in Chuuk and went to Oregon where he finished high school and some courses in college. He came back to Chuuk to finish his Associate Degree in Teacher Preparation to become an elementary school teacher. His desire to become a teacher is motivated by his experiences working as a Sports Coordinator for an after-school program that provides sports as well as academic support to elementary and high school students. After graduating from the college, he

plans to further his studies and finish his Bachelors Degree before going into the teaching profession.

***Aprilyn.*** Aprilyn is 20 years old, single, and is from the island of Moch of the Mortlocks Region. The Island of Moch is about 20 hours from the main island of Weno travelling by ship. Her mother is from Moch and her father is from Liberia, Africa. Aprilyn learned most Chuukese culture from her relatives. She plans to go off-island after finishing her Associate Degree in Teacher Preparation to pursue her Bachelors Degree.

***Melva.*** Melva is 22 years old, a single mother from the Island of Tol in the Faichuuk Region which is about 20 minutes boat ride from the main island Weno. She learned Chuukese culture from her parents and social studies subjects taken in elementary school. She plans to teach in the elementary after finishing her Associate Degree in Teacher Preparation. She also plans to take the 3rd Year Certificate in Teacher Preparation while teaching, if the program is offered in the college in the future.

All of the participants were my students in their lower math classes prior to registering in MS/Ed - 210 Math for Elementary Teachers class. Academic performance in prior classes was not a criterion in the selection of participants. Sylfran, Melva, and Marivic are among the participants who failed and repeated math classes that I am teaching prior to registering MS/Ed 210 - Math for Elementary Teachers.

### **Sources of Data and Instrumentation**

***Survey.*** A pre-survey questionnaire designed to determine the initial perception of the participants about the use of cultural practices and activities to teach mathematics in the classroom was given to the participants upon officially registering the course (Appendix C). A post-survey questionnaire designed to determine the changes in the

initial perceptions of the participants about the use of cultural practices and activities to teach mathematics in the classroom (Appendix D), impact of activities in their mathematics learning and in their future teaching career was given to the participants after submitting their narrative story.

***Journal.*** The participants were required to write a journal for each lesson that was taught using cultural practices and activities. It was designed to determine participants' reflections about class and the specific cultural practice and activity that were used to teach the lesson in relation to the lessons specific student's learning outcome. (Appendix E)

***Narrative Story.*** At the end of the study, the participants wrote a narrative story about all their experiences for the whole duration of the study. The narrative stories were written in the participants' own format or following the guide questions provided to them. (Appendix F)

***Interview.*** In depth interview was conducted with the participants during and at the end of the study to validate and ensure reliability of data presentation and analysis. During the initial coding of data collected from the pre and post survey questionnaires, journals, and narrative story, reflection of each participant that needs clarification and elaboration were noted and were clarified through informal interview with each participant.

***Field Notes.*** I used field notes to keep a detailed record of every observation by taking notes during and after each class. Observations were focused with the lessons taught using cultural practices and activities as well as on the participants and their activities, interaction and conversations with each other and their classmates. Field notes

were also used to keep record of interviews with each participant. This was used to triangulate and understand the written reflections of the participants.

### **Role of the Researcher**

In this particular research study, I play the dual role of being the teacher as well as the researcher.

I am a Filipino, born and raised in the Philippines. I came to Chuuk on September 11, 1995 after being recruited directly from the Philippines to teach in this college mathematics courses that are often remedial in nature with the exception of MS 100-College Algebra (then Elementary Algebra) and MS/Ed 210-Math for Elementary Teachers (then coded as MS/Ed 100a and afterwards coded as MS/Ed 110a). Since 1995, I have been the sole teacher for MS 100 and MS/Ed 210 in the college.

The college administration requires and encourages instructors to use various methods and strategies in teaching all topics and meeting all the student-learning outcomes listed in the course outline (Appendix G).

In this research study, as the teacher, I selected the topics from the course outline that will be taught using cultural practices and activities as well as selecting the appropriate cultural practice and activity that correspond to each of the selected topics. Based on the chosen topics and cultural practices and activities, class activities that are investigative in nature were developed and implemented. During the implementation of said activities, my main role was an observer but shifted to being a class participant from time to time. Observation focused on the behaviors, interactions, and participation of all students but more specifically on those of the research participants.

## **Confidentiality**

I keep all data from the field notes of observations and interviews, survey questionnaires, journals, and narrative stories in a secure and safe location. Only my University of Hawai'i advisor, teachers in the project and myself have access to the data, although legally authorized agencies, including the UH Human Studies Program, can review research records. I will destroy all information that can be linked to the identities of individuals after the researcher transcribed and analyzed the written observations, stories and journals, within a reasonable time, upon the completion of the study.

## **Research Process**

I am the researcher as well as the teacher of the pre-service teacher's course MS 210 - Math for Elementary Teachers. In line with the requirement of the college to use the best possible methods of teaching and assessing students' learning in at least one of the courses they teach every school term, I chose to use cultural practices and activities to teach selected topics in MS 210 - Math for Elementary Teachers.

Lessons taught using cultural practices and activities were observed and recorded using teachers' observation log (field notes), survey questionnaires, reflections of participants collected in their written journals, notes from interviews, and narrative stories of the pre-service teacher participants were transcribed and analyzed.

***Lesson Preparation.*** I chose lessons from the MS 210 - Math for Elementary course outline and taught them using appropriate cultural practices and activities chosen by the teacher/researcher. Elders of the community were consulted regarding the selected cultural practices to ensure accuracy and maintain respect to the culture. The members of the community consider these elders as the most knowledgeable when it comes to culture.

Each of the elders has their own Chuukese culture expertise. Their immense knowledge of the culture was passed down from generation to generation by their parents. These elders served as consultants for project MACIMISE. The researcher, being a participant of project MACIMISE, worked with these elders prior to this study.

***Pre-Survey.*** I distributed survey questionnaire before classes started. The survey questionnaire was designed to solicit participants' initial perception on teaching mathematics using cultural practices and activities.

***Lesson Implementation.*** I implemented the chosen cultural practice and activity in teaching the lessons, observed and recorded observations in an observation log book as the participants engaged in the chosen cultural practice and activity. After each lesson taught using cultural practices or activities, participants related their reflections on the teaching and learning process that occurred in their course journal.

***Narrative Story.*** At the end of the term, each participant wrote a narrative story about their experiences on the mathematics lessons taught using cultural practices and activities.

***Post-Survey.*** At the end of the semester, I distributed a post-survey questionnaire to the participants to determine changes in their initial perceptions about the study and the impact of the study on their mathematics learning and future teaching profession.

***Patterns and Themes.*** The observations and interviews recorded in the field notes of all the lessons taught using cultural practices and activities, reflections in participants' journals, the pre- and post survey questionnaires were analyzed and were continually compared to search for patterns and emergent themes.



***Triangulation.*** Triangulation of the emergent patterns and themes was achieved during in-depth interviews of selected participants in order to gain deeper understanding of their reflections and experiences on the lessons taught using cultural practices and activities.

### **Data Analysis Process**

The research data were analyzed using the qualitative case study analysis approach. Data triangulation was achieved using the observations recorded in the teacher/researcher's field notes of all the lessons taught using cultural practices and activities, the participants' reflections as recorded in their course journals, and the transcripts of the participants' pre-and post- survey questionnaires. These were analyzed to search for patterns and emergent themes as basis for a keener insight on their reflections and experiences on the lessons taught using cultural practices and activities.

### **Lesson Using Cultural Practices and Activities**

The development of class activities for this study is based on one of the four possibilities of how ethnomathematics fit into the teaching of formal academic mathematics investigated by Rowland and Carson that "ethnomathematics should be used as a springboard for academic mathematics" (Rowland and Carson, 2002, p. 92).

Although Rowland and Carson signified that there are those opposed to this possibility, this research study built on the prospect that cultural practices like weaving, building traditional house, and other cultural practices can be used as a foundation to the teaching of formal classroom mathematics. These cultural practices and activities can provide a bridge to teaching formal mathematics in the classroom.

This is consistent with translation, a mode of transforming ethnomathematics ideas in western math curriculum, identified in the study by Dickenson-Jones. It refers to engaging students with cultural practices and activities to accomplish student-learning outcomes associated with western mathematics (Dickenson-Jones, 2006).

#### **Four Culturally Based Activities Used in MS 210a**

Student's learning outcomes required by the preservice course MS 210a - Math for Elementary Teachers were carefully selected as well as the appropriate cultural practices and activities to meet the learning outcomes. Lessons, investigative in nature, were developed using Roland and Carson's (2002) possibilities of integrating cultural practices and activities and Dickenson-Jones' (2006) translation.

The fourth activity was developed based on the model developed by a study conducted to "provide pre-service teachers with experiences of culturally responsive mathematics teaching that they could take with them into their own teaching" (Avirell et. al. 2009, p. 162). The holistic model uses a selected cultural practice and activity as a theme to build mathematical concepts.

For the fourth class activity, I chose the Chuukese Traditional Torch Fishing as a theme to build mathematical concepts that will accomplish student-learning of MS/Ed 210 -Math for Elementary teachers.

#### **Patterns.**

MS/Ed 210 - Math for Elementary Teachers student-learning outcome (SLO) 1d. identifies certain patterns either in numbers, symbols, manipulatives, and natural phenomena to solve word problems and 1d. describe, extend, analyze, and create a wide variety of patterns. The making of traditional Chuukese Lei was used to develop a

culturally based class activity to accomplish the said SLO (Appendix H). The classroom activities included the following...

**Mwaramar: Chuukese Traditional Lei Making.** Students were divided into groups and each group was required to bring to class all materials needed to make at least two traditional lei. The class started with lei making activity where each group was required to make two different lei.

**Table or List.** After making two traditional lei, each group filled the provided table and listed the name of the flowers or colors or number of same flowers in each of their lei in the order that they were placed in the lei they created.

**Identifying Patterns in the Lei.** The members collaboratively tried to identify patterns on the lei that they made by analyzing the table they created then describe the pattern that they recognized after which they recreated their list based on the pattern they recognized.

**Written Report and Worksheet.** The students were required to write a written report on the traditional lei. The report includes the significance and use of the traditional lei in Chuukese culture, the process of making lei, defining pattern, describing repeating pattern, and growing pattern in their own words. The worksheet was based from the required textbook of the course that includes extending arithmetic and geometric patterns.

**The Chuukese Counting System.** MS/Ed 210 - Math for Elementary Teachers student-learning outcome 2. the students will be able to demonstrate competence in understanding numbers, ways of representing numbers, and relationship among numbers, numeration, and its operations and 2a. develop number sense for whole numbers and their

four fundamental operations. To accomplish the said SLO, the researcher chose to use the Chuukese Counting System.

**Activity Preparation.** The students were required to research about the Chuukese Counting System using the Internet and interviewing elders in the community. Specifically, their research included Chuukese number names, numeral classifiers and how to form numbers in Chuukese.

**Group Sharing.** In class, each member of the group shared their research and discussed how numbers are formed in Chuukese and formed examples.

**Group Reporting.** Each group was given a chance to report to the class. Group discussion followed using a question and answer approach.

**Comparison.** Each group compared similarities and differences between the Chuukese numeral system and the Hindu-Arabic numeral system.

***Tupw nú: Collecting Coconuts for Chuukese Feast.*** MS/Ed 210 - Math for Elementary Teachers student-learning outcome 2b. model and explain the processes of addition, subtraction, multiplication, and division and describe the relationship between them. To accomplish the said SLO for addition, the researcher used the traditional way of gathering coconuts for a feast.

**Activity Preparation.** A group was assigned to report to class the traditional way of gathering coconuts for a feast and how the person in charge regrouped the coconuts ready for distribution. The teacher worked closely with the assigned group as a consultant on mechanics of the group presentation.

**Presentation and Modeling.** The group started by a narrative process of how coconut is a part of a traditional feast. The group used available materials around the

school campus to model how the person in-charge of the feast regrouped the coconuts that were brought by village people to the feast.

**Model Application.** The group showed how the concept regrouping is applied in addition of numbers.

**Written Report and Worksheet.** The students were required to write a written report on some Chuukese traditional feasts and their corresponding functions and how gift giving plays a role in the said feast. The worksheet is taken from the required textbook of the course that includes other investigations in addition of whole numbers.

The fourth activity was developed based on the model developed by a study conducted to "provide pre-service teachers with experiences of culturally responsive mathematics teaching that they could take with them into their own teaching" (Avirell et. al. 2009, p. 162). The holistic model uses a selected cultural practice and activity as a theme to build mathematical concepts.

For the fourth class activity, the researcher chose the Chuukese Traditional Torch Fishing as a theme to build mathematical concepts that will accomplish student-learning of MS/Ed 210 -Math for Elementary teachers.

***Téén: Chuukese Traditional Torch Fishing.*** Using the traditional torch fishing as a theme, the students will go through the experience of investigating and teaching the mathematics of a cultural practice and activity that may be used as a stepping-stone to teach classroom mathematics. No particular SLO was considered nevertheless; the researcher was confident that this cultural practice will be able to meet some of the course's SLO's.

**Activity Preparation.** The participants of the study were required to research on traditional torch fishing for the class.

**Report.** In class, the participants will discuss to class how traditional torch fishing is practiced in Chuuk. The participants also demonstrated in class how to make the different fishing torches, and gave some of their classmates the opportunity to try to make fishing torch.

**Discovering Mathematical Concepts.** Each group was required to discover mathematical concepts they perceived to be imbedded in the traditional torch fishing and the possibility of using the concept as a springboard to teach classroom mathematics.

**Group Report.** Each group reported to class the mathematical concepts they discovered and provided examples on how it could possibly be used to teach classroom mathematics.

## **CHAPTER 4. DISCUSSION OF FINDINGS**

This semester-long study investigated the initial perceptions of six students registered in the pre-service course MS/Ed 210 - Math for Elementary Teachers about using cultural practices and activities to teach classroom mathematics as well as changes in their initial perceptions, if any. The study also determined the impact on the participants' learning of mathematics and discussed the participants' perceptions of the potential implications of their experiences in the project in their future teaching practice.

Lessons from the required course outline and appropriate cultural practices and activities were carefully selected to construct an investigative class activity to achieve student-learning outcomes that corresponded with each selected lesson. They were implemented in the classroom to provide the participants with experiences of culturally based mathematics.

The participants responded to a pre-survey and post-survey questionnaire and wrote reflections in their journals about their experiences after each lesson taught using cultural practices and activities. Additionally, the participants wrote a narrative story of their reflections about their semester-long experience with culturally based mathematics implemented in the classroom.

Data collected from these responses and reflections were analyzed to construct the journey of each of the participant based on the questions that this study attempts to answer. Following the principle of "members check" of Lincoln and Guba as conferred by Percival (2004) in her discussion of case study methodology, written copies of the journeys were provided to the participants to read and were discussed with the researcher to ensure accuracy.

This chapter presents the journey of each of the participants using the framework provided below.

- **Introduction.** The introductions to the participants' journeys were based on their responses to the narrative story question guide 1) Why did you agree to participate in this education research project? and 2) what were your initial impressions about the research project?
- **Before the Journey Began: Initial Perceptions.** Discussion of the participants' initial perceptions about using cultural practices and activities to teach mathematics in the classroom based on their responses to the pre-survey questionnaire and their narrative story to the second guide question above.
- **Journey Through the Lessons: Pathways to Changes and Impacts.**  
Presents the reflection of the participants for each of the cultural activity implemented in the classroom based on their written journals and narrative story question guide 3) Describe your reactions to the lessons taught using cultural practices and activities. Looking through these reflections provided insight into how the participants' perception changed and how culturally based mathematics impacted their learning and future teaching practices.
- **Journey's Destination: Impact and Changes in Perception.** Changes in the initial perception of the participants as well as the impact of using cultural practices and activities in their learning of mathematics and their perceptions of the potential implications of their experiences in the project in their future teaching practices are described based on their responses to the post-survey and their written narrative story question guide 4) Were you comfortable in



learning mathematics through cultural practices and activities? 5) What impact, if any, do you feel this research project has on your impression about using cultural practices and activities in teaching mathematics? and 6) what impact, if any, do you feel did your participation in this project have on your future career as an elementary school teacher?

### **The Journey of Melva - The Unbeliever**

My opinion it is not good for that using cultural practice to teach mathematics lessons because our culture here is difficult for others to understand Chuukese Cultural (Presurvey).

Melva's journey in this study began with complete disbelief. She joined the research project because it was the first time a project like this was done in the college. Having fully understood the intent of the project, she wanted to take the opportunity to be one of the first students to "to learn this new curriculum" that she hopes will help to increase her mathematics achievement (Narrative Story).

She had some hesitation because she was nervous about the idea of her statements being tape-recorded. She was afraid that she might say something that is "nonsense and somebody hear it" (Narrative Story). For this reason the researcher opted not to tape record informal interviews and use field notes instead.

### ***Before the Journey Began: Initial Perceptions***

Lessons that used cultural practices and activities were difficult to understand and made Melba feel bored and sleepy. She declared, "No one should use cultural practices and activities to teach lessons" (Presurvey).

Her experience in the Introduction to Professional Teaching and English classes did not help her change her mind and might have added to if not being the source of her

disbelief. In those classes, students learned the importance and uses of Chuukese cultural artifacts. They watched movies and pictures of Chuukese legends. Although she found watching the pictures and movies about cultural legends kind of interesting and that they tended to motivate her, she was quick to add that the lessons that preceded the movies and pictures just confused her (Presurvey).

Additionally, she said that it is difficult to use cultural practices and activities. Teachers might not know how to integrate culture in classroom lessons resulting in students' difficulty and confusion, prompting her to prefer other methods. She concluded, "I want to teach the lesson in my own method, the way the students understand" and not through cultural practices (Presurvey).

### ***Journey Through the Lessons: Pathways to Changes and Impacts***

"So many questions in my mind," exclaimed Melva, before the first activity. Among the many questions she asked herself were, (1) which among the many cultural activities is the researcher going to use in the classroom, (2) how would these cultural activities fit into the mathematics lessons, and (3) will using these cultural practices was going to help develop Chuukese mathematics' skills (Narrative Story).

### ***Mwaramar: Chuukese traditional lei making***

Melva testified, "I'm happy and really like, I like the way I learned or the way my teacher teach us to identify if it's any patterns on our lei if it's repeating or growing patterns." She enjoyed learning how to make the Chuukese traditional lei. She found it easy to discover patterns using the name or the color of the flowers used in making their lei. She also did not have any problem designating the patterns as either repeating or growing (Journal 1).

However, she disclosed that extending the patterns was a challenge for her. She found it challenging to figure out what will be the 100th flower or color based on the recognized pattern. She also experienced difficulty with numerical patterns when doing her worksheet. She struggled to make the connection between the patterns she discovered with the lei and the numerical patterns in her worksheet. This suggests that she is having difficulty in making the transition from the cultural activity to the activities found in their textbook (Journal 1).

### **Chuukese Counting System**

After investigating the Chuukese counting numbers and comparing them to the Hindu Arabic numeral system, Melva concluded that it is easiest to learn both of the number systems (Journal 2).

She related that learning how to form numbers in Chuukese was something new to her. She always knew how to count in Chuukese but never considered how numbers are formed. Looking back to her elementary education, she said that she learned the English equivalent of the lower Chuukese numbers, but was not taught how to form Chuukese counting numbers along with numbers in the Hindu Arabic numeral system (Journal 2).

She also claimed that learning how to form Chuukese counting numbers first before learning counting numbers in English would be the easier way to learn both number systems (Journal 2).

Finally, like some of the other students, she was fascinated to learn about the number "kit" because she never encountered the number before (Journal 2).

### ***Téén: Chuukese Traditional Torch Fishing***

In this activity, Melva is team-teaching with her co-participants a mathematics lesson they developed as they investigated traditional Chuukese torch fishing. Her participation in the activity was very minimal, and so it is not surprising that she did not mention anything about her own experience of doing part of their presentation. She did make the observation that the class actively participated and shared their ideas during the discussion. Hence, she concluded that the students were happy with their presentation and were engaged in the class activity (Narrative Story).

She was very happy to have learned a lot of things from their presentation. She learned how to make the fishing torch and estimating the number of torches needed to fish. She also learned how to determine the average catch using torch fishing, which was the focus of their presentation (Journal 3).

She revealed, however, that she disliked the "other way" to find average because it confused her (Journal 3). She was referring to the two definitions that Filemino wrote on the board. One was taken from the textbook and the other was taken from the dictionary.

On the other hand, despite not being confident of accomplishing their student-learning objective, she concluded that the cultural activity helped the students in achieving the learning outcome (Journal 3).

### ***Tupw nú: Collecting Coconuts for Chuukese Feast***

"I feel good about our lesson," Melva divulged. Collecting coconuts for a feast was something new for her. It was a challenge for her to understand and find the right number words of the Chuukese counting system for coconuts bundled in tens, but she enjoyed learning the new Chuukese counting words (Journal 4).

As to the student's learning outcome, she was not sure it was accomplished. This might be the reason why she did not mention this in her reflection about the lesson (Journal 4).

### **Journey's Destination: Impacts and Change in Perception**

"I am so proud of me," was Melva's reaction as she finished one of her MS/Ed 210 course activity. Her experience in this course somehow enhanced her knowledge in learning and teaching mathematics (Narrative Story).

#### ***Learning through Culturally Based Mathematics***

Melva admitted culturally based mathematics made it easier for her to understand lessons in mathematics.

"I really enjoy most of the identify patterns on our lei because it's really easy to just say the name of the flowers and we know if it's growing or repeating" (Journal 1).

On the counting numbers activity, she said, "I think that's the easiest way to learn counting numbers" (Journal 2). On torch fishing, she disclosed, "I like or enjoy when we find the average because it's easy..." (Journal 3). Finally on collecting coconut activity, she admitted, "I feel good because I learned a lot of things..." (Journal 4).

The cultural activities also motivated her to be engaged and have fun in all the activities. She claimed that she engaged herself in the activities because it was fun and it was "kind of easy" (Narrative Story).

On the other hand, she encountered difficulty when the cultural activity used to teach the lesson was not familiar to her. In most cases, it dealt with Chuukese counting names (Narrative Story).

### ***Future Career and Culturally Based Mathematics***

Melva admitted that her experience with culturally based mathematics developed in her the desire to become a teacher. She said she was not really interested in becoming a teacher, but her experiences with the cultural activities changed her mind. She said that her participation in research study provided her "tools on craft" when she became a teacher in the future (Narrative Story).

She also stated, "If someone doesn't like to become a teacher, but if they learn in this way of learning, it can change their mind to becomes a teacher in the future." She stressed that all they need to motivate them is to experience the same experience she had in this course (Narrative Story).

### ***Change in Perception about Culturally Based Mathematics***

Melva's experience in MS/Ed 210 completely changed her negative perception about using culturally based mathematics.

She developed the outlook that culturally based mathematics is a better way to learn and teach mathematics. She claimed that integrating culture with the school mathematics curriculum made it easier to learn and understand mathematics. She enjoyed and had fun with all the culturally based mathematics activities. Moreover, she said she did not like the "lessons without cultural practices" that we did in the classroom (Post Survey).

Additionally, she believed that using cultural practices and activities could bring about changes to education and school system. She proposed that the curriculum in the elementary should be modified into a culturally based mathematics, and that teachers should undergo the same experiences that she had in the classroom (Narrative Story).

She is confident that the method will not only change the way teachers teach, but it will also change teachers' attitude towards teaching. They will be more encouraged to teach and enjoy teaching because they are using their own culture (Narrative Story).

Finally, she claimed that culturally based mathematics will improve student learning of mathematics, because they will be motivated to participate in the activities and be engaged in the learning process (Narrative Story).

These perceptions are completely opposed to her initial view that no one should use cultural activities in the classroom.

### **The Journey of Chonfan - "No Idea but Hopeful"**

Honestly I did not know what I was getting into but I'm glad to do this project. Have you ever done something without knowing what's in it for you? (Narrative Story)

Chonfan started the research project without any idea about using cultural practices and activities in teaching mathematics. He had heard about it and thought it sounded difficult (Presurvey).

He did not know what he was getting into when he agreed to participate in the study. He claimed, "I threw myself into doing this project hoping for something good that I can benefit something out of it." Like any new adventure he is unfamiliar with, he was nervous and anxious waiting for the project to begin (Narrative Story).

### **Before the Journey Began: Initial Perceptions**

"I don't know how cultural practices are used especially in mathematics" (Presurvey). This is the only answer the pre-survey extracted from Chonfan when asked about culturally based mathematics.

### **Journey Through the Lessons: Pathway to Changes and Impacts**

I was very surprised about the lessons being taught using cultural practices and activities. I did not know that we could actually solve and develop math lessons through or by using cultural practices and activities. (NS, Q 3)

For Chonfan, experience with culturally based mathematics was a revelation. He felt that it was almost like playing and learning at the same time (Journal 1). Responding to the inquiry about the parts of the activities that he disliked most, he said that the part of the journal that asks what he disliked most is actually what he disliked most. He was having too much fun to even consider what he disliked in the activities (Journal 1).

#### ***Mwaramar: Chuukese Traditional Lei Making***

"I like it a lot!" exclaimed Chonfan as he went through his first experience with culturally based mathematics. He was very surprised to be learning mathematical patterns through the Chuukese traditional lei. He was familiar with the leis and had watched people make them, but he did not realize it could be a source of teaching and learning mathematics (Journal 1). He admitted, "We did not realize that we were actually making patterns until our respected instructor, Danie Mamangon, told us to observe the leis we made" (Narrative Story).

During the activity, he observed that the leis they made formed different types of pattern. He describe them as continuing patterns and repeating patterns. Continuing pattern is the word he used to describe growing patterns. He concluded, "I think it was the easiest way to identify each type of pattern" (Narrative Story).

#### ***Chuukese Counting Numbers***

Like the first activity, Chonfan enjoyed learning about the Hindu Arabic numeral system through investigating the Chuukese counting system. He was confused at



the start of the activity, but focusing on the lesson made it easier for him to understand the Hindu Arabic system by comparing it with his knowledge of the Chuukese counting system (Journal 2).

He observed that the Chuukese counting numbers is very much like the Hindu Arabic number system. Learning to write numbers by combining number names was a new approach to teach counting. He disclosed that he did not learn counting that way in elementary school. He said they just memorized the English equivalent for the Chuukese counting numbers like 'ewe' is one and so on. "Because of this," he admitted, that all this time he thought that the "U.S. came up with the system" (Journal 2).

The challenge came for Chonfan when the study of numbers went into the decimal numbers. He wrote, "I don't like the tenths, hundredths, etc., numbers." The decimal numbers confused him. This could be because the Chuukese counting system does not have decimal numbers (Journal 2).

### ***Téen: Chuukese Traditional Torch Fishing***

"I actually used to go torch fishing when I was young but I never taught I can use the activity to do math," related Chonfan (Journal 3). He was so confident that the torch activity made it easier for him to understand the concept and solve for the average.

He maintained that he enjoyed and learned a lot from the activity, but he failed to mention anything about his experience with the group as they researched on torch fishing and investigated what math concept they were going to teach using this cultural practice. His reflection, written in his journal, were all about how he learned as a student, but failed to write about his experiences as a member of the group that taught average using torch fishing.

However, he said that there are other concepts in mathematics that can be taught using the activity. The first thing that he thought about was to teach solving word problems using this activity, but not averaging (Journal 3).

### ***Tupw nú: Collecting Coconuts for Chuukese Feast***

Chonfan felt very strongly that all elementary teachers should use this cultural activity to teach addition and subtraction in their classrooms instead of "just numbers." He asserted that students find it difficult to understand addition and subtraction when taught abstractly (Journal 2). He explained,

If a teacher uses coconuts or figures instead of just adding numbers, it would be a lot easier for students to add. For example:  $20 + 7 \rightarrow$



Here elementary students would be able to see the figures and they would count them and then they would know what 20 is and be able to understand.

He added that elementary students would be able to 'see' the process of the operations as they observed what happened to the objects, and would be able to understand what their answers mean (Journal 4).

### **Journey's Destination: Impacts and Changes in Perception**

The project was not easy but it was fun and interesting and that's what kept me going. I'm glad I made the right decision on agreeing to do this project. (Narrative Story)

The journey of Chonfan in MS/ED 210 cultivated some perceptions about the use of cultural practices and activities in teaching mathematics rather than provoking major changes in his perception about culturally based mathematics. He had no idea about culturally relevant pedagogy until he experienced undergoing lessons taught using Chuukese cultural practices and activities.

### **Learning through Culturally Based Mathematics**

Chonfan admitted that he was surprised to experience mathematics lessons taught using cultural practices and activities. He related,

We actually learned pattern through making leis. We learned how to identify whether it is a continuing or repeating pattern. I was also surprised when I learned that the Hindu-Arabic numeral system is almost the same or close to the Chuukese counting system (Narrative Story).

He understood mathematics lessons through the cultural activities he experienced in the class. He claimed he never understood these mathematics concepts when he was in elementary school (Narrative Story).

The lessons taught using cultural practices and activities changed his attitude towards the learning of mathematics. He confessed that he was "always bad in math" and he never liked mathematics until his experience in this course (Narrative Story). For him, the lessons that were taught using cultural practices and activities made him feel like he was back in the elementary school classroom learning "math the right way". He admitted that he never understood the mathematics he learned in elementary school. He feels that the project has changed the way he "used to think about math" and has a significant impact in his interest as well as appreciation of mathematics (Narrative Story).

### **Future Career and Culturally Based Mathematics**

In relation to his future teaching practice, Chonfan commented, "The research project really prepared me to become or to be able to teach math to elementary students" (Narrative Story). He wants to be a teacher in the future because he loves to work with young people, but doubted his ability to teach effectively. He was afraid he might fail the students because of his own weakness in math. Recalling how he was taught mathematics

in elementary and how he struggled through the lessons, he feared he might do the same to his future students

Culturally based pedagogy provided him an alternative teaching method where students don't "memorize each numbers and their value" which was "very discouraging and boring" (Narrative Story). With the experience, he feel ready to teach mathematics in elementary classrooms confident that his students will enjoy learning and understand mathematics.

### **Change in Perception about Culturally Based Mathematics**

Chonfan's involvement with the research study provided him with some new views regarding the use of cultural practices and activities in teaching classroom mathematics lessons.

First of all, he realized the possibility of using cultural practices and activities in teaching classroom mathematics. He was surprised to experience solving and developing lessons from culture. He also admitted that the classroom activities using culture were great. "The cultural practices and activities made the lesson more clearer and understandable" (Post Survey). He claimed that he had no difficulty with the mathematics lessons that were taught this way. For him, the cultural practice and activity motivated him to be engaged in the lesson and he enjoyed learning as well. He said, "It is almost like playing with toys and learning at the same time" (Journal 1).

Furthermore, he realized that using culturally based mathematics is not only an effective strategy to teach classroom mathematics but "a good way to teach the culture to the young generation". Learning mathematics through cultural practices and activities

should be preserved so that the younger generation will be able to use their knowledge of their culture to learn lessons provided in the classroom (Narrative Story).

### **The Journey of Marivic - To Experience is to Believe**

I feel so eager in wanting to graduate soon so that all the great ideas I have in my head, I just wanna pour them all out to my students to learn all these incredible new ideas of teaching math lessons using cultural practices and activities (Narrative Story).

There's a notion among the older generation here in Chuuk that you cannot say no. Saying no should be done in a very courteous manner by offering an alternative. Marivic thought she didn't have a choice when offered and so she agreed to join the project. She felt that her teacher is counting on her to do her best by being picked out among the rest of her classmates (Narrative Story).

Reminded by the other participants that they can chose to quit anytime they feel uncomfortable with the study, Marivic said it's too late because she enjoyed being a part of the team, so much so that the thought of quitting was far from her mind. She was motivated to stay with the team even if they got to do the hardest class works (Narrative Story).

### **Before the Journey Began: Initial Perceptions**

Marivic did not have a particular perspective regarding using cultural practices and activities to teach mathematics. She felt the need to experience it first to see the impact of using culture-based in her own learning of mathematics, so that she could compare it to her learning of mathematics through the traditional method that was mostly through lecture. However, she conjectured that using cultural practices and activities to teach math may be easy and more fun because students will get the lesson or solve the problem easily if they enjoy the cultural practice and activities (Presurvey).

She also thought that if we can use culture to teach mathematics, we will "find a way of learning more than repeating or parroting the lessons from a textbook" (Presurvey). She welcomed the great opportunity to learn new ideas. She perceived that cultural practices and activities would be like "a new edition of the textbook" that will enhance the understanding of mathematics teachers who taught their courses in ways that lead to memorization (Presurvey).

### **Journey Through the Lessons: Pathways to Changes and Impacts**

I doubt the cultural activities to have any good impact on the lessons from class. But as soon as we go over all the activities I was stunned on how it really did work (Narrative Story).

#### ***Mwaramar: Chuukese traditional lei making***

Marivic came a little bit late to class, entered the classroom and sat with her group mates who were sorting the materials they brought to class for their activity. While waiting for instruction, they started asking each other why are they going to make a lei and what does it have to do with their mathematics class.

It was a surprise revelation to her how she learned to recognize patterns out of making and examining the Chuukese traditional lei.

She had fun making traditional lei with her classmates and was amazed to see that the patterns they are learning could be discovered from their own traditional lei. She realized that "the lesson" they "learn in class and the cultural practice or activities are connected." The connection between the traditional lei and the pattern they were learning lead her to "understand the lesson very well" (Journal 1). She states, "In fact, we've got many 'ohs' when we were learning the new lesson using cultural practices and activities" (Journal 1).

### ***Chuukese Counting System***

Marivic's familiarity with the Chuukese counting numbers was challenged during this cultural activity. Investigating how the Chuukese numbers are formed and the different classifiers was not something she learned at home or school. She enjoyed learning how to form any number in Chuukese. Her confusion and frustration came when their group started to talk about the word "*me*" which is used to connect the tens number names and the ones number names; for example, eleven in Chuukese counting is "*engon me ewe*" which is a combination of "*engon*" (number name for ten) and "*ewe*" (number name for one) connected by the word "*me*". She wrote, "I felt confused because I grew up learning that, but nobody tell me why we use it" (Journal 2).

She narrated that she enjoyed the activity because investigating her own number system lead to a better understanding of the Hindu Arabic Number System. She found learning both number systems more fun the way it was done in the class. She said, "as much as I enjoyed it, I know that my students will enjoy it, too" (Journal 2).

### ***Téen: Chuukese Traditional Torch Fishing***

This activity provided the participants the experience to investigate a cultural practice and discover mathematics that they can teach in the classroom. Marivic thought that the group was all confused in the beginning. They seemed to have forgotten how to make the Chuukese torch and what is it for. She felt that students criticized her presentation, but said didn't mind because that was some validity to their comments (Journal 3).

During their presentation, Marivic was impressed how the students shared their ideas especially when one of the students almost took over her presentation and explained

how to make the torch in their region. The thing she enjoyed most was developing the chart to find out if the students understood the lesson. She was impressed with the students cooperation and how "easily they catch the lesson from our cultural practices" as she watched the students fill up the worksheet their group prepared for the class (Journal 3).

### ***Tupw nú: Collecting Coconuts for Chuukese Feast***

Among all the culturally based lessons done in class, this activity made Marivic see that the mathematics lessons we are learning from the cultural activities were the same lessons that were found in their textbook. She explained, "The lesson that we try to express through the cultural practices that we use is similar to the student-learning outcome that we also learn during class", comparing the lessons as should be taught using the required textbook (Journal 4).

The activity also impressed her how we can learn the "modern lesson" from the "cultural practices". She says, "I really enjoy it. It makes me see clearly the lesson that had been taught" (Journal 4).

### **Journey's Destination: Impacts and Change in Perception**

The impacts that has on me to be prepared is when I stand in front of class the day we perform our presentation on the fishing torch, my being nervous ease and I felt like I am already a teacher teaching my students (Post Survey).

### **Learning Mathematics Through Cultural Practices and Activities**

Marivic declared, "I enjoy all the lessons" (Narrative Story). By all the lessons, she meant those that were taught using cultural practices and activities as well as those that were taught with different methods and strategies. Albeit, she claims that "the lessons that had been taught by cultural practices are much more fun to enjoy". She was



motivated because she learned and experienced something new and she felt that it was more challenging (Narrative Story).

She also found the lessons taught using cultural activities made mathematics easier to understand. She believed that the reason was her familiarity with the culture. She was able to visualize the mathematical concept through the cultural activity (Narrative Story).

She remained very uncomfortable, however, with solving problems. Problems solving she said, "just get on my nerves." She recalled how she and her group were working on a problem in their worksheet trying to figure out how many Chuukese torches they had to make in order to catch certain number of fish. Because she could not figure it out, she kept asking her group mates to explain to her over and over again how they figured it out. She admitted that she couldn't seem to solve mathematics problems because she "cannot stand word problems" (Narrative Story).

This implied that for Marivic, mathematics problems are word problems. She could not make the connection that everything they did in class with the cultural activities was problem solving. In the lei making activity, she was able to recognize patterns from the lei they made and was able to describe and extend the patterns she recognized from the lei. She did not realize that doing this was problem solving and that she had fun doing it and enjoyed the activity.

### **Teaching Mathematics Using Cultural Practices and Activities**

Marivic took an education degree not by her own choice, but in compliance with her mother's wishes. In spite of not wanting to teach she thought that being in the field of

education could be a starting point of a political career. She is will graduate this term if she passes all her classes.

She was very happy to have gone through the experience of culturally based mathematics teaching and learning before she graduates. She believed that the experience helped a lot to be ready for a teaching career. She was confident that teaching mathematics using cultural practices and activities has a significant impact on her readiness to teach. "I can see just from my class that the class I will teach in elementary will enjoy my teachings based on cultural practices and activities". This projected confidence stemmed from her enjoyable experience learning and teaching mathematics using culture. It provided her with new ideas on what and how to teach students in elementary school (Narrative Story).

Aside from developing readiness and confidence in teaching, she also has developed the zeal to be in the teaching profession. As she said, "I feel so eager to graduate soon so that all the great ideas in my head, I just wanna pour them all out to my students" (Narrative Story).

### **Change in Perception About Culturally Based Mathematics**

Marivic's initial attitude about culturally based mathematics was ambivalent. She did not disagree nor agree about the concept. She wanted to experience it first to see whether it is feasible or merely a different way of using the textbook (Presurvey).

She was willing to participate in the study because it was a chance to look at new ideas or maybe look at something "like a new edition of the textbook" that are required for all her other courses in college. She thought that it would be like learning by reading,

memorizing and "parroting" the textbook, but in a more enjoyable way because students are more familiar with cultural activities than what is in the textbook (Presurvey).

Somehow, her experiences in the class changed this attitude. She was convinced that culture is a better source of learning mathematics, because students can see them and can actually do them because it's their own culture. She found students more actively engaged in the activity and more aggressive in sharing their ideas based on her experience during their group presentation on torch fishing (Journal 3).

She also found it easier to learn the lesson using the cultural activities because they worked together and learned together which is a part of Chuukese culture. She also revealed that culturally based mathematics encourages and stimulates the teacher to teach actively in class. It equips them with a way of teaching that produces excitement in the classroom that can motivate better teaching (Narrative Story).

### **The Journey of Sylfran - Experienced but not in Mathematics**

In my own opinion, based on my experiences as an islander, it's a really good idea. It's where students in a classroom get a clear picture of what it is that you are actually talking about (Presurvey).

Sylfran participated in the study to find out what it would bring to her. It was her first time to be invited to participate in any project at the college. Moreover, culturally speaking, it would be rude to say no to older folks, particularly those who are in an authoritative position, especially priest and teachers, without any good reason. Thus she was puzzled why she was chosen to join the project (Narrative Story).

After being oriented to what the project was all about, she decided to agree to participate in the project, which she describes as "once in a life-time opportunity" so that she can look back and be proud of this new experience in her education (Narrative Story).

### **Before the Journey Began: Initial Perceptions**

Sylfran believed that using cultural practices and activities to teach mathematics is a good idea. Culture gives students a clear picture and idea of what is being taught in the classroom. It presents to students familiar items in contrast to things that are not found in Chuuk like skyscrapers. The cultural practices and activities are Chuukese own idea and students are familiar with them and have known from their childhood and it is not "something that has been introduced" written from "someone else's point of view and understanding" (Presurvey).

### **Journey Through the Lessons: Pathways to Changes and Impacts**

Now what would a math class be doing bringing needles and threads to class when this is not a sewing class? And what would flowers have to do with math (Narrative Story).

This was the reaction of Sylfran when her group mates informed her about what she had to bring for next meeting's lesson. She was absent when the assignment and instruction for the next day activity was announced in class. It was the first lesson using cultural activity that they will experience in class.

### ***Mwaramar: Chuukese traditional lei making***

The lesson was fun, Sylfran declared. The making of the lei made the activity enjoyable. She felt free to make anything beautiful out of the flowers they brought to class. She also thought it was nice to work together like they were just at home. Likewise, she thought that making the lei is a good activity to do in the classroom because some "modern students" don't know how to make Chuukese lei even when all materials were available. Additionally, she thought that the lei provided a lot of patterns that can be discovered (Journal 1).

### ***Chuukese Counting System***

This activity was a delight to Sylfran: learning how to count with learning how to say Chuukese numbers. She found that studying the Chuukese counting as a number system fascinating especially when learning how numbers are formed and discovering how similar the Chuukese system was to another system in the world (Journal 2).

She recalled that, in her school days, the study of counting numbers was never approached the way it was done in this class. She was taught the English equivalent for Chuukese numbers but never tried to study in depth how numbers may have come about and how numbers are formed. She narrated, "Also, in our early years when learning how to count objects and recite the numbers our teacher never taught us of where the numbers came about and how they were formed" (Journal 2).

### ***Téen: Chuukese Traditional Torch Fishing***

Standing in front of the class, she related, was "the most terrifying thing". She doesn't like talking in front of people but admits that it was "good practice" for her, that it should develop her confidence in teaching because she is "suppose to be a teacher" (Journal 3).

In their presentation, she noticed that students raised a lot of questions—this bothered her. Because she felt everything "were already explained", she felt the students were not focused on the lesson and were more "focused on us standing in front" (Journal 3). She also declared that when she becomes a teacher she would "stay away from this concept" because she is terrible in mathematics (Journal 3).

### ***Tupw nú: Collecting Coconuts for Chuukese Feast***

Sylfran found the lesson from this activity "something that was not too hard to understand". She observed that her classmates learned a lot of things because they could actually see a "clear picture of " the concept of mathematical operations and felt it "will strengthen their addition and subtraction" abilities (Journal 4).

### **Journey's Destination: Impacts and Change in Perception**

I think it's wonderful! I don't know how Mr. Danie pulled it off but he's just so brilliant. The lessons were fun and creative (Post Survey).

Sylfran expressed her delight in all the activities and lessons taught using cultural practices and activities. She narrated that she liked engaging and learning through the cultural practices and activities (Narrative Story).

### **Learning Mathematics Through Cultural Practices and Activities**

"I was not so good in math," Sylfran admitted. She did not hate the project but she thought that she was terrible in doing mathematics problem. The mathematics part challenged Sylfran through out the project (Narrative Story).

The cultural activities made the lesson fun for her and made her enjoy the class. She is notorious for missing classes. She had to repeat her mathematics course, including this class, and her other courses as well, because of absences. The study changed all that. She was motivated to attend class regularly. She disclosed, "These cultural activities that were going about in our class was something that fully motivated me to keep coming to class". She didn't like to miss the fun that she was anticipating to experience in class. "Though I felt sick at sometimes, still I managed to come to class and have fun". Learning mathematics through culture was something new to her and she didn't want to miss the activities (Narrative Story).

She also disclosed that aside from enjoying the lesson, she found learning mathematics using the culture comfortable in spite of all the challenges of doing the mathematics. She revealed that her experience "has changed the way that I think and once felt towards math" (Narrative Story).

### **Teaching Mathematics Using Cultural Practices and Activities**

Sylfran aimed and was more comfortable teaching English and Social Studies. Her experienced in the study added mathematics to the list. "Now that I have learned this type of teaching method, I can now say that teaching math will not be a problem" (Narrative Story).

She wanted to teach mathematics through cultural practices and activities to her future students to see if the students will feel the same way the she felt learning mathematics through cultural practices. She also wanted to teach young students that are struggling in mathematics the way she learned how to do mathematics using cultural practices and activities (Narrative Story).

### **Change in Perception About Culturally Based Mathematics**

The experience of Sylfran in MS/Ed 210 confirmed her perception about culturally based pedagogy. She liked that the lessons presented through cultural activities because she was able to visualize the mathematics concept they were learning.

She also disclosed that the cultural practices and activities motivated her and encouraged her to regularly come to class. She did not want to miss classes because she loved learning math through culture cause it was "like taking history and heritage only better." She also described culturally relevant pedagogy, as "a new way of learning" she

did not want to miss. She did not encounter any other math classes that used cultural practices and activities to teach classroom mathematics (Narrative Story).

### **The Journey of Aprilyn - Balance of "Western Way" and Culture**

At first I thought, this project seemed impossible. As I moved through each of the cultural activities, my views began to gradually change. I found out that it is easier and more effective to learn and teach math through the approach of cultural activities and practices. I've possessed a positive impact toward the use of cultural activities and practices in teaching math. I declared that it is best to learn and teach math using cultural activities and practices (Narrative Story).

The journey of Aprilyn began with skepticism and doubt about the possibility of using culture in teaching formal classroom mathematics. She asked herself, "Is this even possible, teaching using cultural practice"? This was something she was not familiar with. Gathering information about it confused her more. She entertained the feeling that she must have misunderstood what the project was all about (Narrative Story).

In spite of all those doubts, skepticism, and a lot of questions running in her mind, she agreed to participate in this study for various reasons.

She felt special for being chosen to participate in the study. She sensed that the teacher must have a lot of trust and confidence in her to have been offered the chance to participate. This motivated her to agree and commit to fully support and seriously engage in the all the lessons (Narrative Story).

She also was pushed by her curiosity on the use of cultural practices and activities in mathematics lessons. This curiosity produced eagerness and anticipation to "move on and actually observe the possibility, the effectiveness" of integrating culture and formal classroom mathematics in the teaching and learning process (Narrative Story).



She considered the possible implications to her career and Chuuk education if indeed the study was successful. The success of the project might be beneficial in helping the education system of Chuuk develop or improve its mathematics curriculum. Furthermore, it may also equip her with knowledge, change her personal views of teaching methods, become a more flexible teacher, and provide the skill to deliver lessons through cultural activities (Narrative Story).

### **Before the Journey Began: Initial Perceptions**

Aprilyn doubted the possibility of using cultural activities in teaching formal classroom mathematics. She could not visualize how culture can be a source of mathematics lessons. She never had any experience with culturally based mathematics. She learned mathematics in all her math classes using the textbook required by the College's course outline.

In spite of that, Aprilyn believed that if it was possible to use cultural practices and activities to teach and learn mathematics in the classroom, it should be balanced with or be a supplement to textbook-based lessons and activities (Presurvey).

In her responses to the pre-survey questionnaire, she argued that students trained via pure cultural practice and activities might be incapable of adjusting to a different learning environment outside of Chuuk. She pointed out that most of the younger generation has adopted, not only the modern ways of living and practice which is "mostly western ways", but also has assimilated the western ways of learning because almost all courses use western textbooks. She suggested that most students have the desire to go to the US for possible employment and further their studies and must be familiar with mainland ways of learning and teaching. But she quickly indicated that based on her own

observations, trained rigorously in textbook-based teaching, "students are more likely to lack skills and knowledge" because of teachers' emphasis on memorization and imitation (Presurvey).

She sees accomplishing both in the Chuukese classroom will be a huge challenge for teachers, thus recommended a "balance" of "both ways" should be seriously considered (Presurvey).

### **Journey Through the Lessons: Pathways to Changes and Impacts**

At first, I was immensely eager to find out what the intention of weaving the leis and if it is relevant source to learn mathematics (Journal 1). It was my first-time ever experience to observe and learn math out of my own cultural activities (Narrative Story).

#### ***Mwaramar: Chuukese traditional lei making***

Her experience with the first lesson, patterns through traditional lei making, served as an eye-opener for Aprilyn, in the use of cultural practices and activities in teaching mathematics. The activity captured her interest because she realized that through cultural activities she could learn mathematics effectively.

Reflecting on her experience and learning with the lesson, she expressed that she enjoyed identifying patterns found in the two lei their group had woven. The whole lei did not follow a single pattern because they made the lei out of the available materials they brought to class. Nevertheless, she was able to work her own way discovering the patterns on some parts of both lei. Extending the pattern she discovered was challenging for her, but she liked it because it made her think creatively in devising a plan to recognize the patterns. Although she found identifying and extending patterns in the lei easier than with the geometric figures and numbers from the textbook, she was able to figure the textbook questions out using her acquired knowledge of patterns in the lei. She

writes, "I observed almost everyone from the class as they fixed their assigned worksheet No. 2, everyone seemed to understand what to do. This means, we are progressively able to recognize patterns" (Journal 2).

She also shared her reflection of the whole process of using cultural practices and activities to teach mathematics. She expressed that the method "is effectively a reliable source to acquire math... and will serve as a good approach to teaching mathematics" (Journal 1). She further described the process as "an enhanced way to learn and teach mathematics" (Journal 1). She found it interesting to know that she can learn mathematics through her own culture.

On students learning, she related, " I want the future children to view their culture as something valuable" despite the fact that it has been influenced with modernized ways or lifestyle because she believes that by teaching mathematics through culture, " they will be able to learn effectively and successfully" (Journal 1).

### ***Chuukese Counting System***

This activity offered Aprilyn her first encounter with the Chuukese counting numbers discussed inside the classroom. "I never remembered touching into this lesson while I was in elementary", she declared (Journal 2).

She enjoyed learning how to form numbers in both the Chuukese counting system and the Hindu Arabic Number system. Her experience in the activity gave her an understanding of how numbers came about, expanded her knowledge and skills in counting numbers as well as "delivering the lesson" (Journal 2).

### ***Téén: Chuukese Traditional Torch Fishing***

I extremely feel excited and motivated about the lesson. I finally earn an opportunity to experience how to teach a lesson out of cultural activities (Journal 2).

Given the opportunity to develop a lesson out of cultural activity excited the participants including, Aprilyn. She could take a cultural activity assigned to their group and use it to teach a lesson. She enjoyed the class participation as their group demonstrated how to construct the fishing torch. They explained the math lesson that they believed was appropriate to integrate with the cultural activity (Journal 3).

Reflecting on the students' learning based on the lesson's learning objective, she thought that the students were not able to completely meet their objective. They were able to compute the average catch for each torch, but could not describe what an average was. Aprilyn was probably referring to an example the group wrote on the board indicating the number of catch for each torch used. The students were able to provide the average, but could not explain what that value means. The range of catch per torch that they provided during their presentation, she observed, made the students do a lot of thinking to determine averages and filling the table Aprilyn's group provided as a worksheet for their classmates (Journal 3).

Her experience of actually teaching with her group mates made her conclude "that using cultural activities in class is indeed fun and effective" (Journal 3).

### ***Tupw nú: Collecting Coconuts for Chuukese Feast***

Just like the other cultural activities done in the class, Aprilyn felt excited and motivated because the lessons challenged her thinking and creativity. She related that all

the lessons integrating culture and classroom mathematics expanded her understanding of concepts she learned in school (Journal 4).

She related that learning to add and subtract using regrouping through the gathering of coconut for Chuukese feast finally made her understand "the borrowing and the carry-over thing". She also mentioned that, "I always was confused with subtraction when we borrow one, but we get ten instead. The teachers never make clear about this" (Journal 4).

Reflecting on students' learning, she said that it is widely known in Chuukese culture that coconuts is grouped by tens. Through the "image of coconut grouping" the students will be able to understand addition and subtraction clearly and easily (Journal 4).

### **Journey's Destination: Impacts and Change in Perception**

I was motivated to learn math through cultural activities. The lessons encourage me to fully engage myself into the class activities and discussion. It helped developed my thinking skills and interest in pursuing the teaching methods via the use of cultural approaches (Narrative Story).

### **Learning Mathematics Through Cultural Practices and Activities**

For Aprilyn, it was the first time to learn mathematics through cultural activities. She was motivated and delighted to learn mathematics by discovering the mathematics from cultural practices and connecting it with the classroom mathematics lesson derived from the course outline. For her, the knowledge she acquired from the mathematics of the cultural activities shed light on some principles of mathematics she learned through algorithm and imitation without understanding the mathematics behind them. She wrote, "In elementary, I was taught that there is this thing called 'borrowing' in subtraction. I noticed it doesn't make sense, but I never accommodated a better explanation of this". Learning the same concept through the grouping and regrouping of coconuts brought as a

gift to the village chief for distribution during a Chuukese feast, she declared, "I eventually found the answer or explanation I have been looking for. Indeed, the cultural activities helped me understand things that I failed to understand" (Narrative Story).

She was also very comfortable in learning mathematics via cultural practices and activities. She actually claimed that, "it is easier and more effective to learn and teach math through the approach of cultural activities" and declared "that it is best to learn and teach math using cultural activities" (Narrative Story).

Although she expressed that the cultural activities had very positive impacts in her learning of mathematics, she admitted that the approach was not without challenges. She encountered difficulty learning math through cultural activities; e.g., being unaware of some Chuukese culture and variation of Chuukese language from region to region. Growing up in a "modernized Chuukese society", she was not familiar with a lot of cultural practices and activities. It was a challenge for her to find the right words for counting numbers and identifying cultural practices and activities (Narrative Story).

She suggested that teaching formal classroom mathematics using cultural practices and activities was a comfortable way for students, and motivated them to learn mathematics and provided opportunities for in depth understanding of mathematical concepts. The culturally based approach encourages students to fully engage in the learning activity, and to be involved in their own learning through a lot of thinking and self discovery (Narrative Story).

However, this approach requires a certain degree of familiarity with the cultural activities used to impart the mathematical concept. Moreover, culturally based mathematics, since it provides experiences in actual performance of the cultural practice

and activity in the classroom by students that are not familiar with them, could contribute to the rejuvenation of their desire to preserve and respect their culture.

### **Teaching Mathematics Using Cultural Practices and Activities**

Mathematics is one of Aprilyn's favorite subjects. In fact, she was an A student in my MS 100-College Algebra class. She likes mathematics but is very pessimistic about teaching mathematics. She said, "I realized that I do not have the potential to teach mathematics". Because of this, she abandoned her plan to become a math teacher. She claimed that her desire to become a teacher is "born with me" but not in elementary school and not mathematics. She would rather venture in other fields like English or Social Sciences and teach high school (Narrative Story).

Her experience in the class changed this view. She developed her confidence in teaching mathematics in the elementary school. She conceded that her "plan has changed again" and further admitted "taking part in this project has enabled" her "to be knowledgeable and skillful in teaching". She expressed confidently that she "will be an outstanding teacher influencing and teaching elementary students through cultural activities and practices" (Narrative Story).

She also pointed out that her lack of familiarity with some aspects of her culture would also cause her difficulty with teaching. "I found it hard, because at one point, I did not know what torch fishing is, and how it is used and its cultural importance". She managed her presentation, however, by gathering information from some sources, like the elders in her community, relatives, and classmates and through research in the Internet (Narrative Story).

This indicated the positive impact her experience of learning and teaching mathematics using cultural practices and activities in MS/Ed 210-Math for Elementary Teachers. It motivated her to pursue teaching mathematics and gave her confidence about her teaching skills and ability (Post Survey).

Her experience also implied that difficulties in using culture could be overcome by readily available resources found in the community.

### **Change in Perception About Culturally Based Mathematics**

Aprilyn started the class full of disbelief in the possibility of using cultural practices and activities to learn and teach classroom mathematics. This doubt provided eagerness and anticipation to experience her first culturally based lesson. After one and a half weeks into the class, it finally came.

This first experience dramatically changed her perception about the possibility of culturally based mathematics in the classroom. Quoting from her journal for the lei making activity she wrote,

I realized that it is really decent basis of learning mathematics. It is effectively a reliable source to acquire math. Through cultural activities, I can still learn math effectively. Serve as a good approach to teaching mathematics (Journal 1).

This indicated that she believed culturally based mathematics lessons were effective method for teaching mathematics. She also thought that the mathematics she learned through the use of cultural practice is the same mathematics to be learned as required by the course outline. It is interesting that after referring to it in the pre-survey questionnaire, she never mentioned textbook based learning and teaching again. A possible reason for this could be because she realized that the mathematics she learned through cultural practices and activities is the same mathematics required to be learned by



the course outline. Her learning through culture was more than just memorizing and imitating teacher solved examples, but rather an in-depth understanding of mathematical concepts as in the case previously mentioned about "borrowing and carry-over".

She reflected about her future students indicating that using cultural practices and activities to teach classroom mathematics may be able to enhance students' understanding of mathematical concepts and lengthen retention of skills and knowledge acquired. Furthermore, it could expedite students' learning and boost their mathematical skills, because it provides students with hands-on participation in their own learning (Narrative Story).

She also implied that unfamiliarity with the culture could be a challenge in using culturally based mathematics but could be overcome, because there are readily available resource such as elders in the community, parents and relatives, and classmates. Modern technology is also available for gathering knowledge and information about culture (Narrative Story).

Moreover, culturally base mathematics in the classroom rejuvenates the desire to learn or relearn one's own culture as well and appreciate its significance for education. There are differences in culture practices across the various regions of the state. Aprilyn was not familiar with all these different aspects of Chuukese culture. Being a participant in this study she "was able to find pleasure in learning the cultural values and practices of the other parts of Chuuk". Additionally, because of her participation in this study, she found renewed interest in learning the culture, realizing its significance in education (Narrative Story).

Furthermore, she initially did not think that it was good to teach and learn mathematics using cultural practices and activities. By the end of her involvement with the study, she was confident "that it is best to learn and teach math using cultural activities and practices" (Narrative Story).

### **Journey of Filemino - Firm Believer**

I am sure the teachers out there are sticking to the curriculum alone. I don't think they're using cultural activities to teach the subject. They're strictly textbook type. So I'm on a mission now. I will follow the curriculum my way. Because I think if the students are interested in something, the lesson taught will stick. That's what I believe (Journal 2).

Among all the participants of the study, Filemino was the only one with teaching experience. In spite of not finishing any degree in the field of education or other related field, various high schools in Chuuk hired him to teach different courses. He taught English at Pentecostal Light House Academy, mathematics at Saramen Chuuk Academy and culture at Xavier High School. Because he did not finish any degree, his employment with these educational institutions were short-lived and made him decide to come back to the college to finish his degree and teach elementary level after graduation, preferably on his home island.

Although he taught mathematics and he taught culture, he "did not teach math using the Chuukese culture". Curious as to how these two separate fields could be integrated to teach mathematics motivated him to join the project (Narrative Story).

### **Before the Journey Began: Initial Perceptions**

Filemino believed that some cultural practices involve mathematics and using cultural practices and activities to teach classroom mathematics will "definitely make young kids learn more and know more when they can relate to something they already

know." The students may be able to connect culture to mathematics because of their familiarity and experiences with the culture. Having experienced teaching, Filemino, was aware of the significance of the role of prior knowledge for students' learning (Presurvey).

He also claimed that the culture motivates students to engage in their learning because of their familiarity with their own cultural practices and activities. He added that the motivation factor is also true with the teachers. When teachers see their students motivated to learn and actively participating in class activity, they teachers will be more confident in teaching. He spoke about his own experience teaching culture in high school; "I think I enjoyed it because I knew what I was doing and also because it made me feel good to see students getting motivated doing and building stuff outside the classroom" (Presurvey).

He also noted that culturally based mathematics provided opportunities for the community to be involved in the education of its citizens. In culturally based mathematics "community will always have a part, either from home or at school" (Presurvey). Culture may provide students, parents and other relatives, elders, and other members of the community, a common ground of involvement in the learning of their citizens. Chuukese believe in the old African proverb "*Unusen ewe soopw epwe mwokut fan iten fefeitan emon semirit.*" which literary means that it takes a whole village to educate a child (Mariano Marcus, e-mail communication). The integration of culture in classroom instruction offers an opportunity for the whole community to be a part of and involved in the education of its youth.

Using cultural practices and activities to teach classroom mathematics requires competence and experience of both culture and mathematics. Implementing the blending of these in the classroom "at first may seem difficult with those who haven't had any experience relating math with cultural aspects" (Presurvey). Furthermore, future teachers must have adequate knowledge of formal classroom mathematics as well as sufficient expertise of the cultural practices and activities they intend to use, so that they will be "creative in giving out the lesson so that it's fun and at the same time it's productive" (Presurvey).

However, Filemino pointed out that some cultural practices that have mathematics are only known to a few people and are in "danger of becoming extinct." He saw this as the weakness of culturally based mathematics (Presurvey).

### **Journey Through the Lessons: Pathways to Changes and Impacts**

Unlike the other participants, Filemino anxiously waited for the first activity, not to see if it's possible to teach math using culture, but to experience learning a mathematical topic from the curriculum using cultural practices and activities. He definitely believed that there was mathematics in the culture and he wanted to see how the integration of both was accomplished in the classroom (Narrative Story).

#### ***Mwaramar: Chuukese traditional lei making***

"I think it's really amazing how you can make a lei and form an equation out of that", related Filemino after the first cultural activity in class (Journal 1). He found it challenging and their group realized that it "wasn't exactly easy" to discover patterns from the lei, but thought that crafting the lei made it easier to understand the concept of patterns (Journal 1). He also observed that in the lei, pattern is always formed "without

the maker being conscious of it." He concluded that when taught patterns through lei making, the students "find it easier to understand because they're the ones who made the lei" (Journal 1).

### ***Chuukese Counting System***

Filemino was aware of the existence of Chuukese counting numbers, because children learned the number names at home. He was not aware, however, that the system was published in a textbook and taught in most classrooms. He enjoyed his classmates sharing their thoughts on how counting numbers are formed, and was enlightened to see the variation of spelling by colleagues from different regions of Chuuk. The class, he observed, realized that there was a Chuukese counting system, and that "Mr. Danie's" lesson motivated them to be involved in the discussion to find out more about the number system (Journal 2).

He declared that making them aware by investigating the Chuukese counting numbers helped them understand the Hindu-Arabic number system better.

The activity inspired him to form a "special group" to do an in-depth study of the Chuukese number system, as well as other cultural practices and activities, for publication, something that may serve as a reference for teachers to use in the classroom. It also motivated him to share the teaching method to other teachers from his island that "are sticking to the curriculum" and are "strictly textbook type" (Journal 2).

### ***Téen: Chuukese Traditional Torch Fishing***

For this activity, Filemino taught a mathematics lesson using cultural practices and activities for the first time. He felt very excited. His group investigated torch fishing and used it to teach the concept of average (Journal 3).

He was a little frustrated because his groups' preparation did not work out well. He thought initially that the presentation would end up badly, but after seeing it believed that it didn't go badly at all. He was surprised how smoothly the presentation was with his group mates talked about the history of torch fishing, demonstrated how to make a torch in class, and how the other students in the class shared variations of the activity in their own region and how differently they made the fishing torch (Journal 3).

He sensed that he confused his classmates when he explained average by using the torch. He saw that most of the students looked confused. Furthermore, he observed that most of the class was not familiar with the concept of "the least amount of catch and most amount of catch". It seemed that it did not make sense to them (Journal 3).

He felt that given the choice, he would use a more familiar activity like spear fishing and line fishing that is more popular form of fishing at present (Journal 3).

#### ***Tupw nú: Collecting Coconuts for Chuukese Feast***

"Adding eleven, thirteen, and seventeen was made more clearer when we grouped the tens ( $10 + 3$ ,  $10 + 1$ ,  $10 + 7$ ...) regroup the left-overs ( $3 + 7 + 1$ ), and we're able to come up with "*faaf me efou*" (four bunches (10) of coconuts and one)," explained Filemino as their group was investigating the collecting of coconuts for a Chuukese feast (Journal 4).

He said that the coconut regrouping makes it easier for students to visualize the concept of addition. However, he felt that it would "stick in their heads" more if they "actually get their hands on the materials for the lesson" (Journal 4).

The challenge for Filemino came when Marivic mentioned that there is a grouping of coconuts other than ten in the culture, but Marivic could not recall what it

was called. She suggested that it goes like "*tuken ruanu*" which literary means "container with four" but did not guarantee the accuracy of her memory. The fact that Marivic, as well as himself did not know this way of counting, caused Filemino to lament, "I thought I would no more about Chuukese culture", and felt bad that none of the class knew "names of groups of 2, 3, 4, (and so on) of coconuts" (Journal 4).

### **Journey's Destination: Impacts and Change in Perception**

After the first lesson was given (making of the *mwaramwar*), I became excited and wanted to learn more about other cultural practices that would create a mathematics lesson out of (Narrative Story).

"I wanted to see what was going to happen," was Filemino's reaction before the research project started. "Excited and wanted to learn more" was Filemino's state as the project was going on. As the project culminates he declared, "Now I am armed with my 'new weapon' I am ready go to out and 'set the world' of schooling on fire" (Narrative Story).

### **Learning Mathematics Through Cultural Practices and Activities**

The experience of learning mathematics using cultural practices and activities ignited the desire of Filemino to learn more mathematics. He wrote, "When I realized the many ways that you can use any cultural practice to solve math problems, I became excited and wanted to learn more". He believed that he needed to be more competent in mathematics content in order to develop mathematics lessons out of the culture (Narrative Story).

Engaged in hands on cultural activity with actual materials made the lesson clear and easy to understand. The students could distinguish the connection between the mathematics lesson and the cultural activity comfortably while they are working on them.

He related that they were able to identify patterns by observing the name or color of the flowers in the table they created from the lei they made and predict "what color of which particular flower would show up at the number one hundred" (Narrative Story).

He declared, "Wow, this is easy." Performing the cultural activity prior to the formal lesson helped him in acquiring knowledge of mathematical concepts needed to understand the lesson, and for creating their own strategies for solving problems (Narrative Story).

Filemino noted that the difficulty and the challenge was when they came across cultural concepts that they were not familiar with. Although he understood the concept taught through the activity, it frustrated him not to know some aspects of certain cultures and felt that "it was embarrassing" (Journal 4).

### **Teaching Mathematics Using Cultural Practices and Activities**

Filemino thought that after getting his degree, he would teach elementary using the textbook and the curriculum framework required by the department of education. However, his experiences in MS/Ed 210 - Math for Elementary Teachers' class provided him a different outlook of how to teach. He wanted to teach mathematics using a lot of different Chuukese cultural practices and activities. He was convinced that integrating cultural practices and activities in the required elementary curriculum was a better method to teach mathematics in the classroom. He professed, "I am sure the teachers out there are sticking to the curriculum alone. I don't think they're using cultural activities to teach the subject. They're strictly textbook type. So I'm on a mission now. I will follow the curriculum my way" (Narrative Story).



This suggest that he developed the motivation to bring the experiences he had to his future classroom teaching, and affect a change to how traditionally teachers approach teaching the mandated Chuuk State Mathematics Curriculum Framework.

He also realized through his experience in the class that it would also be possible to use cultural practices to teach other fields such as English, science, and so on. Convinced of this possibility, he developed the desire to show other teachers how to teach the required curriculum using cultural practices. Additionally, he wanted to share with them how the method can enhance the learning ability and understanding of their students.

However, he also felt the need to learn more about the Chuukese cultural practices. He is convinced that sufficient knowledge about culture is essential to successfully teaching culturally based mathematics and other fields (Narrative Story).

### ***Change in Perception about Culturally Based Mathematics***

The experience of Filemino in MS/ED 210 - Math for Elementary Teachers did not so much change his perception about culturally based mathematics. His experience with the class more than anything else confirmed and broadened his initial perceptions.

After going through all the lessons that used culturally based mathematics, he realized that all cultural practices involve mathematics. He initially perceived mathematics in some cultural practices but not all. He claimed that he knew building a canoe and canoe house deals with a lot of mathematics, but he admitted that he never thought of other cultural activities like the traditional lei making and torch fishing done in the class could also be a source of mathematics lesson (Narrative Story).

He also perceived that these cultural activities could be used in fields other than mathematics. Culturally based pedagogy is not limited to mathematics. Implementing the teaching technique is possible in other disciplines (Narrative Story).

The role of the community in culturally based pedagogy extends not only to the involvement of the students, but to teachers as well. The observation of Filemino on the need to learn more about the cultural practices of Chuuk to effectively implement culturally based mathematics appeals to the members of community who are knowledgeable in culture, so that these people can be enlisted to share their expertise with the teachers.

## **CHAPTER 5. Conclusions, Implications and Recommendations**

MS/Ed 210-Math for Elementary Teachers is the only content and method mathematics course at the College of Micronesia-FSM, Chuuk Campus. The course undertakes the task of preparing pre-service teachers by providing the required content using various teaching strategies and methodologies in a manner that is significant to students and their culture. It was thought that using Chuukese cultural practices and activities in teaching classroom mathematics could be one way of accomplishing this task.

Ezeife (2002), in his discussion of the interaction of mathematics and culture, encouraged presentation of mathematics concepts using culture because it is significant to the students and it helps them to form their own mathematical meaning of concepts presented. He claims that it is a commonly assumed fact that every educator is aware that one factor that influences learning are the students' experiences acquired through their life at home and in their community, which they bring into the formal classroom.

Having deduced from relevant literature that advocated the use of culturally relevant pedagogy, and motivated by the various culturally based mathematics curriculum developed by the participants of the MACIMISE program across the Pacific region, the researcher/teacher set out to develop investigative activities to teach selected topics in mathematics as required in the course outline of MS/Ed 210. The investigative activities deemed appropriate and congruent with Chuukese cultural practices and activities were presented to the students registered in the course. The research project started by soliciting the initial perceptions of six purposefully selected participants using a pre-survey questionnaire distributed before the first day of class. During the semester,

students were required to write in a journal their reflections after each of the cultural activity they engaged with in the class. After all the selected topics were taught, they responded to a post-survey questionnaire and wrote narrative story about their experiences in under taking the culturally based mathematics activities. The journals, responses to the post-survey questionnaire, and the written narrative stories were analyzed to determine changes in their initial perception about culturally based mathematics if any, its impact in their learning of mathematics, and its implications to their preparation as future teachers.

### **The Significance of Experience**

Analysis of responses to pre-survey questionnaire revealed a common theme that almost all the participants had no previous experience with culturally based mathematics activities. Melva and Sylfran experienced a bit of culturally relevant pedagogy in some of their prior courses. Filemino had experience in teaching culture and mathematics separately but not using culture to teach mathematics. Chonfan, Marivic, and Aprilyn had no experience in culturally relevant pedagogy in any field. Until their experience in this course, their perception of using cultural practices and activities in teaching mathematics were based on those experiences in culturally based pedagogy in other fields or they had not experience at all.

Previous experiences of two participants in culturally relevant pedagogy in other fields produced opposing perceptions about culturally based mathematics. Sylfran's prior experiences of learning through culture convinced her of the positive effect of using cultural practices and activities to teach mathematics lessons. She contended that culturally based mathematics would enhance learning through students' engagement with

their own culture because they are familiar with them (Presurvey). On the other hand, Melva's experiences in previous courses that used culture based activities led her to believe that it was not good to use cultural practices and activities to teach mathematics in the classroom. She argued that it would only cause confusion and difficulty for students' learning. She wrote, "I think some teachers, they don't know how to used it that's why I think it is difficult to teachers and students" (Presurvey). Curiously, both Melva and Sylfran experienced culturally based pedagogy in at least one of the same classes required for their degree. This suggest their prior experience had an impact on their perception about their future experience of similar pedagogy regardless of whether it will be on a different field. The positive experience of Sylfran led to a positive perception about culturally based mathematics and the negative experience of Melva led to a negative perception about culturally based mathematics.

The participants without any experience in lessons taught using culture offered hypothetical advantages about culturally based mathematics focused solely on their belief about culture and some theories in education which they might have learned in their previous courses. Although Chonfan had no idea about using culture in delivering lessons in the classroom, he thought that it could be an effective way to teach and learn mathematics because students are familiar with their own culture. Marivic believed that students' familiarity and respect for their culture might be a fun and enjoyable way to motivate them to learn the lesson. She perceived that cultural practices and activities are just like a "new edition of the textbook" required in all courses in the college.

Aprilyn's perception about using cultural practices was focused on her belief that the college should not only educate students to function effectively within Micronesian

community, but should also prepare them meet the challenges of learning and living outside Micronesia. She thinks that if it were possible to teach mathematics using cultural practices and activities, it should be a supplement to textbook based teaching. Culturally based mathematics will provide the students necessary knowledge and skill to function effectively within the Micronesian communities. Nevertheless, textbook based teaching should not be abandoned because students should also be trained to adapt to the "learning and teaching styles" outside of Micronesia. She believes that classroom pedagogy should be a balance between culture- and textbook-based learning and teaching.

Filemino had experiences in teaching various subjects in high school. These experiences provided him with a wider focus for his perception about using cultural practices and activities in teaching mathematics in the classroom. Having experienced teaching at the high school level, he may have been made aware of the importance of the role of prior knowledge and experience of students in classroom teaching and learning. This is evident in his initial perception of using cultural practices and activity in teaching classroom mathematics. He claimed that culturally based mathematics produces effective learning because it uses the prior experience of students. He contended the connection between the mathematics embedded in the cultural practices and activities and formal classroom mathematics can be used as an effective teaching strategy and enhance students learning. Although the students may not be aware of the mathematics embedded in their culture, they are expected to come to the classroom with experiences of their own culture that can be used as a stepping stone towards formal classroom mathematics. These prior experiences can be employed as a motivational tool for students to build understanding and learning of new concepts.

Filemino also perceived that culturally based mathematics enhances the confidence of teachers to teach mathematics. Reflecting on his own experience with teaching culture in the high schools, he claimed he knew what he was doing in the classroom because he is familiar with Chuukese culture.

### ***Implications and Recommendations***

The need for these participants to experience culturally based mathematics to develop perceptions about the effectiveness or ineffectiveness of the process implies that teachers of preparatory courses should provide preservice teachers with meaningful activities that will integrate culture and mathematics in their classroom. Educators teach the way they were taught and not the way they were told to teach. This theory of apprenticeship of Lortie (1975) implies that pre-service teachers' future teaching practices is highly affected by how they were taught as students. This further implies that new teachers are unlikely to teach in a way that they did not experience in the classroom as students. Their perceptions about their experiences may have implications for their future practice as teachers of mathematics and they cannot teach in a way that they have not experienced. Presmeg (1996a) suggested that the first important step in using cultural practices and activities in mathematics classroom is for teachers and pre-service teachers to be made aware of this process through preparatory courses like the one described in this study.

Although this study provided only very minimal number of lessons taught using cultural practices and activities the research revealed the significance of experience upon the perceptions of the participants. In this connection, the researcher recommends that

this study be replicated providing more mathematical concepts taught using cultural practices and activities.

### **Effective Way of Learning Mathematics**

It made lessons easier and understandable (Chonfan, Narrative Story).  
I thought learning the math by performing each cultural practice really helped to open my eyes to see how the problem was done (Filemino, Narrative Story).

I think that if we keep on using or studying this cultural practices and activities, our knowledge in math will improve (Marivic, Post Survey).

I finally realized that through cultural activities, much is much easier and understandable for each of the students to comprehend and apply math lessons (Aprilyn, Narrative Story).

Yes I feel a lot that I have learning in mathematics using cultural practice (Melva, Post Survey).

This class made it fun to learn instead of making it difficult (Sylfran, Post Survey).

Another common theme drawn from the data collected from the participants was the effectiveness of using cultural practices and activities in learning mathematical concepts presented in the classroom. Performing the cultural practices that were done in the classroom made them enjoy learning the concepts of mathematics that were taught in the class as evidenced by the testimony provided above.

### ***Provided Motivation in Various Ways.***

Culturally based mathematics is an effective way to learn because it motivates students in many ways. This is a conclusion that can be extracted from the reflections of the participants after experiencing the tasks developed for the class.

Filemino and Aprilyn were motivated to learn math through cultural practices and activities. Filemino was motivated to learn more mathematics concepts taught using



cultural practices and activities. He wrote that he was so excited and wanted to learn more. After going through the first cultural activity where he learned how to recognize and distinguish patterns through the traditional lei, he felt fulfilled because he was able to connect the cultural activities with the mathematical concepts being taught in class. He exclaimed, "Wow, this is easy," and motivated him to learn more mathematical concepts through cultural activities (Narrative Story). It is the first time that Aprilyn experienced discovering and learning mathematical concepts via her own culture. The lessons taught through culture motivated her to be fully engaged into class activities and discussions. Because of this and in spite of the challenges she faced with the mathematics lesson in class, she claimed that it was "much easier to teach and learn math through cultural activity and practice" (Narrative Story).

Sylfran was motivated to come to class regularly. Sylfran is known among teachers in the college for always missing her classes. She was taking this class for the 3rd time not because she's not smart enough to pass it, but because of her absences. Unlike MS 100-College Algebra that she is also taking under this researcher/teacher this semester, she seldom missed this Math for Elementary Teachers class. She explained, "All these cultural activities that were going about in our class was something that fully motivated me to keep coming to class." She claimed that she managed to come to this class even when she's sick, because she doesn't want to miss the class, and the fun she's having in learning mathematics which was like "taking our history and heritage only better, with a new mix MATH" (Narrative Story).

For Chonfan, the mathematics was not what drove him to be fully involved with the lessons. He related that the cultural activity was what motivated him to be completely

engaged with the activity. For him, the lessons would have been really boring if it were not taught using cultural practices and activities (Narrative Story). This was also true in the cases of Marivic and Melva. They had lots of fun with the lesson and were motivated to learn, because they were taught using cultural activities. Enjoying and having fun with the cultural activities lead them to face the challenges of learning mathematics. In fact, Marivic thought that the cultural practices made it easier to understand the lessons "in a different way" (Narrative Story).

### ***Encourage Students' Active Participation***

Culturally based mathematics is an effective way of learning because it encourages student's participation in class discussions. This is evident not only in the participants' experiences in learning mathematics, but also from their own reflections about participant observations of their classmates reactions to their class presentation on culturally based mathematics.

Aprilyn believed that the lessons taught using cultural practices and activities encouraged the whole class to be fully engaged in all the lessons. She observed,

They actually participated in class discussion. They were delighted to have gone through the experience of learning math through cultural activities. When the first cultural lesson was introduced, they were all in a mood where they couldn't able to wait and witness the actual lesson they will learn from the cultural activities (Narrative Story).

She made the same observation when their group presented the torch fishing activity and taught the concept of average using the said cultural activity. She commented,

When we presented the fishing torch to the whole class, everyone was astonished. They asked questions, they made comments and suggestions and shared what they know (Narrative Story).

Melva shared the same observation as Aprilyn. She also believed that her classmates were all excited, enjoyed the lessons and shared their own knowledge in class discussion. She wrote, "Some of them they share their kind of different using torch to go fishing" (Narrative Story). For Marivic, she related that students sharing their own ideas was the part she enjoyed most in their presentation and singled out how one of her classmates explained clearly how to use the fishing torch in his own region (Journal 3). Similarly, Chonfan could tell that the whole class was fully engaged in the activity by "hearing their reactions to the activities", pointing out that most of them know Chuukese culture, but were not aware that they can learn math through these cultures (Narrative Story).

Sylfran and Filemino had negative reactions to some of the students' sharing, but nonetheless confirmed that the lessons taught using cultural activity encouraged active class participation. Sylfran commented that the question asked by students seemed to have irritated her because she felt that they were already explained in class and added that they were "not focused on the explanations" (Journal 3). However, she admitted that some of them shared other ways that the torch was made, "...and helped them in some of the things that their group did not present in class." She added that some seemed interested because they "chipped in" what they knew about the lesson (Narrative Story). Filemino observed that his classmates were interested, participated in, and shared in the lesson using cultural activities because they wanted to "show off" their skills (Narrative Story) and that he nearly "lost it" when one of the students "took away my class" by explaining the other method of torch fishing (Journal 3).

Overall, the participants were not only encouraged to participate actively in the lessons that were taught using cultural practices and activities, but it was true of the whole class as well. Furthermore, participants observed that the active participation of the whole class was not only evident when the researcher/teacher was facilitating the activity but was true also when they, the participants themselves, were leading the class through a culturally based mathematics activity in the classroom.

### ***Implications and Recommendations***

These results support emerging evidence in mathematics education that advocated the use of culturally-responsive teaching to improve learning experiences by accommodating students' culture, needs, and interest to achieve mathematics learning objectives (Fulton, 2009). It also confirms the belief that using cultural activities makes mathematics meaningful because it responds to the needs of the students. Mathematical concepts delivered in the classroom will be more meaningful to the learners because they can connect it to practices and activities that are well known to them (Adam, Alangu, and Barton, 2003). This is based on the concept that if learners identify themselves with the mathematics they are learning through their culture infused in the curriculum, they will recognize the relevance of learning the mathematics (Bishop, 1988).

However, the relation between the positive perceptions of the participants in the learning of mathematics and its impact to their academic achievement was not considered in this study. Sylfran agreed to participate in the study hoping that the project can help her pass this course (Narrative Story). The researcher therefore recommends that a study be undertaken to investigate the impact of culturally based mathematics in the academic achievement of pre-service teachers in their preparatory courses.

## **Effective Method to Teach Mathematics and Culture**

The experience provided to the participants led them to conclude that using cultural practices and activities was an effective method to teach mathematics and culture. They projected their positive learning experience in culturally based mathematics would be the same experience that their future students would have if they were taught using this approach.

Filemino made this very clear when he responded to the post-survey questionnaire. He wrote, "If we use cultural practices to teach math (for example), children would understand the lesson better and would be motivated in learning more about their own culture" (Presurvey). Chonfan, agreeing with Filemino, wrote, "students are not only learning how to add or subtract, but they are also learning the Chuukese culture" (Journal 4). He added, "This a good way to teach culture to the young generations. It is important for us Chuukese to keep our culture" (Narrative Story). Aprilyn admitted that she did "not give any attention to some cultural practices as something that matter" but realized that "culture is very essential and it's even fit to learning" (Narrative Story), and that culturally based mathematics will lead "children to view their culture as something valuable" (Journal 1). Sylfran believed that using culture was an effective method to teach mathematics because performing the activities and actually creating cultural artifacts, like the lei, provided a visual aid or a manipulative for students to understand and actually see what the teacher is talking about (Journal 4). Additionally she related that this class helped her to understand her culture and consider other cultural practices that she can use to teach mathematics (Narrative Story).

### ***Implementation of Culturally Based Mathematics in Future Teaching Practice***

One indication of participants' perception that culturally based mathematics is an effective method of teaching is their commitment to implement the activities that they experienced in this class in their future classrooms.

All the participants committed themselves to implement the cultural activities done in this class. Chonfan claimed that his future students would enjoy learning through the cultural activities as much as he did and "later on appreciate it." He believed that there are more lessons that could be taught using the activities done in this class like problem solving using the torch fishing. Aprilyn wanted to implement culturally based mathematics if given a chance to teach in the future, because it will make the students understand the process and concepts of mathematics that she never understood before (Journal 4). Melva's commitment to using culture in teaching mathematics was focused on learning outcomes. She related, "Cultural practice is nice to use to teach the lesson, it's easy to help out the students learning outcomes" (Journal 4). Filemino is very precise in his pledge to implement culturally based mathematics in his future practice. He is committed to use not only the cultural practices and activities done in this class, but other cultural practices as well. He commented, "I want to find out all kinds of cultural practices that would match which mathematics lessons. Then I would list them down and file them for future use" (Post Survey).

### ***Culturally Based Mathematics Experience For All Teachers***

The participants' belief that the implementation of culturally based mathematics will cause positive changes in the educational and school system is another indication that using cultural practices and activities was an effective method of teaching. The

participants believed that all teachers in the Chuuk educational system should undergo the same experience about using cultural practices and activities they had in this class.

Interestingly, this idea came from Melva who initially suggested that no one should use culture to teach lessons (Presurvey). After her experiences in this class she suggested that the project should be brought to the Chuuk State Department of Education, with the hope that the department will approve the use of culturally based mathematics in classroom. She believed that teachers should undergo the same experience because she is confident that this project will provide teachers "tools on craft" that will change their mind and attitude towards teaching and produce better academic achievement from students. She explained, "I think if the department of education approve this project for teacher to be using in the elementary school, I think they really good in math because it easy to them to understand because they teach them in their own culture, their attitude will be nice in in their school because they enjoy this new curriculum in teaching students in the elementary school" (Narrative Story).

Filemino was in total agreement with Melva in this regard. Filemino declared that all teachers should be knowledgeable about Chuukese culture and should use this knowledge to teach mathematics. He suggested, "DOE, Chuuk, should implement culture into the curriculum where it would be used to teach the lesson" (Post Survey). He also mentioned that he thought that there is a provision in the national and state constitution enforcing culture to be taught in schools. He suggested, "They really need to make that into a law and apply it." Furthermore, he declared, "I think Chuuk State Department of Education should make it a must that culture should be used in teaching lessons in the classrooms; especially with mathematics" (Post Survey).

### ***Implications and Recommendations***

The results discussed above are in line with Graham's (1982) theory that effective mathematics teaching in any setting should build upon where the children are and must move with the children as they cultivate mathematical concepts in relevant and meaningful situations which are structured for them in such a way that broaden mathematical ideas developed. Many advocates of ethnomathematics believe that the infusion of cultural practices and activities in the curriculum as well as teacher's pedagogy can provide relevant and meaningful experiences to students of mathematics.

The results are also consistent with the finding in the study of Finch (2008) who integrated cultural practices and activities in his teacher preparation course hopeful that it will help pre-service teachers translate multicultural education experience to classroom practice. The study revealed that in spite of their initial belief of their competence integrating culture in classroom mathematics, completing the course that integrated culture, the participants confirmed better understanding of their own selves and how their experiences with culturally based instruction influence their teaching and their relationship with their students. Their involvement of pre-service and in-service teachers' in the course changed their perception and increased "... multicultural education and culturally responsive teaching." (Finch, 2008 p. 253)

This implies that there is a need for teachers and pre-service teachers to undergo training in culturally based pedagogy in order to effect the same perceptions and changes in the traditional way of teaching mathematics among teachers in Chuuk. In view of this, the researcher recommends that a culturally based mathematics' training program for pre-



service and in-service teachers be developed and implemented by the Chuuk State Department of Education using this research study as a framework.

### **Challenges and Difficulties Implementing Culturally Based Mathematics**

Spite of the fact that the participants of the study had fun, enjoyed culturally based mathematics and perceived that using cultural practices and activities is an effective way to learn and teach mathematics in the classroom, they also met some difficulties and challenges in the process.

#### ***Unfamiliarity with Some Culture***

One of challenges that the participants encountered concerns the lack of knowledge about some aspects of the Chuukese culture. They needed to know more about their culture in order to implement the culturally based mathematics tasks.

Aprilyn related that she had no problem with the delivery of the lesson. The difficulty she faced was the lack of access about Chuukese culture that she is not familiar with. She wrote, "I found it hard, because at one point I did not know what torch fishing is, and how it is used and its cultural importance. I was totally unfamiliar with this" (Narrative Story). She added, "I had difficulty looking for the traditional word for the cultural activities, spelling or naming the counting numbers" (Post Survey).

This was also true with Filemino's experiences. He said, "I don't think the lessons were difficult at all. I think they were made easier by using cultural activities. The only difficulty I had was trying to come up with cultural names for number grouping." He added, "The main problem was our little knowledge of the Chuukese culture" (Post Survey).

### ***Using Culturally Based Mathematics Across All Grade Levels***

This concern surfaced with Filemino's reflection about his commitment to implementing culturally based mathematics. He was concerned about his effort in teaching math using cultural practices and activities being for naught if he is the only teacher implementing the method. He declared,

The problem is if I'm the only one using cultural practices in math lesson, other teachers (higher grade levels) need to do the same thing. If I was to teach the third grade level, 8th grade teacher needs to be teaching math using culture as well. If third graders really understand the lesson, when they move up to the levels above (including high schools) it's possible that they may lose interest in math if it's not taught with culture in the upper grades (Post Survey).

### ***Implications and Recommendations***

Teaching mathematics by infusing cultural practices and activities may have an impact on the future teaching practices of pre-service teachers as well as their own learning of mathematics but persuading pre-service teacher to embrace the culture integrated curriculum and pedagogy will not be without challenges.

Matthews (2002), who conducted a study that endeavored to identify and explore the difficulties and the challenges in implementing a model for a culturally relevant teaching of mathematics, found two challenges. One of the challenges was that teachers implementing culturally based pedagogy had insufficient knowledge, familiarity lack of experience with the culture.

This implies that teachers should have access to easily available resources needed to implement culturally based mathematics. This could be done through the Principle Model of using cultural practices and activities in teaching mathematics suggested by Averill, et al. The Principles Model takes into account three different principles that include soliciting the valuable inputs of cultural experts (*partnership*), respecting and

preserving and fostering cultural practices and activities (*protection*), and ascertaining learners access to engage in cultural activities by the members of community concerned (*participation*) (Averill, et. al., 2009).

The researcher recommends that the Chuuk State Department of Education or the local government of Chuuk State put up a Culture Resource Center tasked with preserving Chuukese culture, where the elders of the community who are regarded as cultural expert in Chuuk will be able to contribute inputs about the Chuukese culture, knowledge and experience that will be preserved for all the citizens of Chuuk including students learning about culture as well as teachers implementing culturally relevant pedagogies.

## **Conclusion**

Based on the findings of this study, the infusion of cultural practices and activities in teaching MS/Ed 210a - Math for Elementary Teachers had a positive impact on the perception of the preservice participants as well as their learning of mathematics. Furthermore, it also had a positive impact upon their attitude towards mathematics and implication towards their future teaching practices.

More importantly, being the teacher as well as the teacher of the said course, this research study had a very significant effect in the way I look at how I teach, not only this preservice teacher's course, but all the other courses given to me by the college administrators. My experiences with this study has motivated me to redesign my teaching strategy in all the mathematics courses I teach in the college towards culturally based pedagogy and provide meaningful learning experiences to all of my students through their own cultural practices and activities.

Furthermore, the study made me realize the significance of research in the teaching of classroom mathematics. Through this research, I was made to recognize the importance of the voices of my own students about the way I teach mathematics and how their opinions should be taken into account in the preparation of their own learning activities as well how it should be implemented.

## **APPENDICES**

### *Appendix A: PARTICIPANTS CONSENT FORM*

#### **Selective use of culturally-based mathematics in a pre-service teachers' Course at the College of Micronesia-FSM, Chuuk Campus**

I am Danilo A. Mamangon, a doctoral student at the University of Hawai'i-Mānoa (UH) in the College of Education, department of Curriculum Studies. As one of my duties and part of the requirements for earning my graduate degree, I am doing a research project on topics concerning mathematics teaching and learning. The purpose of my research project is to tell the stories of pre-service teachers registered in the Course MS 210 - Mathematics for Elementary Teachers about their perceptions and growth in using cultural activities and practices in teaching mathematics lessons.

In line with this and being registered in the course, I am inviting you to be one of about 6 participants in the research project.

#### **Activities and Time Commitment:**

As participants, I would like to request that you:

1. Respond to a Pre-survey Questionnaire to determine your initial perceptions about culturally based mathematics.
2. Write in a course journal your personal reflection on the teaching and learning process as I teach some lessons using cultural practices and activities, and meet with me for a 15 - 30 minutes informal interview at a time most convenient for you regarding your reflections written on your journal.
3. Relate your story about your personal perception and growth on your learning experience with the mathematics lessons taught using cultural practices and activities.
4. Respond to a Post-survey Questionnaire to determine changes in you initial perceptions about culturally based mathematics.

#### **Timeline:**

The research study is for the whole term of Summer 2013, which will commence on May, and ends on August.

#### **Benefits and Risks:**

I believe that your participation in this study would be helpful for your future career as an elementary teacher. It will provide hands-on experiences in developing and teaching

lessons using Chuukese cultural practices and activities.

This project will also help me and the mathematics education communities learn more about the use of cultural practices and activities in the teaching and learning process for the benefit of future students.

I believe that your participation in this project will bring you no risk or little risk. However, feel free to choose not to answer any question asked that makes you uncomfortable. If for some reason you change your mind about participating in this project, please feel free to inform me that you want to withdraw from the project.

**Privacy and Confidentiality:**

All data derived from all questionnaires, field notes on class observation and informal interviews, participants' course journal, narrative stories written or spoken, will be kept in secure and safe location. However, access to these will be permitted to my research adviser and members of my research committee at the University of Hawai'i, legally authorized agencies like the UH Human Studies Program, participants of the study and myself.

Moreover, all data derived from all questionnaires, field notes on class observation and informal interviews, participants' course journal, narrative stories, written or spoken will also be destroyed and disposed of properly after being transcribed.

Your identity or any other personal information that will lead to your identification will be kept confidential and will not be used in any part of the research unless you have specifically requested and granted permission for me to do so. Aliases or fake names or letters will be used in referring to you.

If you need access to my final report please see me at the Math and Science office during my office hours and we could agree on a time convenient for both of us to discuss the said final report.

**Voluntary Participation:**

Your participation in this project is completely voluntary. You may choose freely to participate or choose not to. In addition, if you chose to participate, you may at anytime withdraw from participating in the project and your signed permission.

If you have any questions concerning your participation in this research project, please see me at the Math and Science Office during my office hours posted on the office door. Furthermore, if you have any questions regarding your rights as a research participant, you may inquire at the UH Human Studies Program, by phone at (808) 956-5007, or by email at [uhirb@hawaii.edu](mailto:uhirb@hawaii.edu).

**Signature for Consent:**

I am presently registered in the course MS 210 - Math for Elementary Teachers this Summer 2013 and:

A. Agree to participate in the research project on the *"Selective use of culturally-based mathematics in a pre-service teachers' course at the College of Micronesia-FSM, Chuuk Campus"*.

☐ yes      ☐ no

I fully understand my responsibilities as a participant and allowed to withdraw my participation in this project, at any time, by notifying the researcher.

**Printed Name:** \_\_\_\_\_

**Age:** \_\_\_\_\_

**Signature:** \_\_\_\_\_

**Date:** \_\_\_\_\_

*Appendix B: CONSENT TO CONDUCT STUDY*

**LETTER OF PERMISSION TO CONDUCT THE STUDY**

Date: \_\_\_\_\_

**MR.** \_\_\_\_\_

Campus Dean  
College of Micronesia-FSM  
Chuuk, Campus

Dear Sir:

My proposed dissertation study is on the "Selective Use of Culturally-based Mathematics in a Pre-service Teacher Course at the College of Micronesia-FSM, Chuuk Campus".

I am interested in the stories of our "pre-service teacher" students about their perceptions and growth in teaching mathematics using cultural practices and activities based on the experience that will be provided to them in the classroom. I am convinced that the stories they have to tell based on their experiences are significant in the teaching and learning process as well as their personal development as they prepare themselves to be future classroom teachers.

As we are required to assess and evaluate student's learning of at least one of the courses we teach every semester, I would like to ask your permission for me to assess and evaluate MS 210 - Mathematics for Elementary Teachers this Spring 2012 and use the data I gather in completing my proposed study.

I am attaching necessary consent forms, pre-post survey questionnaires, journal questions, and story guide that will be used in the said study.

I would gladly submit to your office a full report on the study upon completion.

If you need further information and questions about the research project, I would gladly come to your office at your most convenient time for discussion, or contact my Supervising Professor, Dr. A. J. (Sandy) Dawson at dawsona@hawaii.edu.

Your approval on this request is very much appreciated.

With sincere respect,  
**Danilo A. Mamangon**  
Researcher

Approved: \_\_\_\_\_

Dean  
College of Micronesia-FSM  
Chuuk Campus

Date: \_\_\_\_\_



### *Appendix C: PRE-SURVEY QUESTIONNAIRE*

I offer my sincere thanks to you for agreeing to participate in this study. The purpose of this pre-survey questionnaire is to ask you some questions about your initial thoughts on using cultural practices and activities to teach lessons in mathematics. I assure you that all information you provide will be kept confidential and your identity will not be disclosed in any part of the final report.

The research study deals with selective use of cultural practices and activities in teaching pre-service teachers course MS 210-Math for Elementary Teachers here at College of Micronesia-FSM, Chuuk Campus.

I would prefer that you use English in answering the questions but please feel free to answer in your own language if it is more comfortable for you.

1. What is your opinion on the strengths or weaknesses of using cultural practices and activities to teach mathematics lessons and concepts?
  - a. In what grade level should cultural practices and activities be used to teach mathematics lessons and concepts?
2. Have you been in any class where your teacher used cultural practice and activities to teach lessons?
  - a. In what class was this?
  - b. What lesson and what cultural practice and activity did your teacher use?
  - c. How did your teacher use the cultural practice and activity to teach the lesson?
  - d. What was your overall impression about the lesson and the class?
3. Did you ever develop mathematics lesson using cultural practices and activities?
  - a. What grade level. What topic in mathematics?
  - b. What cultural practice and activity did you use?
  - c. Were you able to teach the lesson (maybe in a teaching demo in your other method classes)?
  - d. Did you enjoy the teaching the lesson?
4. Do you think it is difficult to teach mathematics lessons using cultural practices and activities? Explain why.
5. What method and strategy of teaching does your teachers use do you enjoy most in your classes? Explain why.
6. Which do you think would produce more effective learning; using textbook and the examples provided in the textbook or using cultural practices and activities? Explain why.

#### *Appendix D: POST SURVEY QUESTIONNAIRE*

I offer my sincere thanks to you for your participation in this study. The purpose of this post survey questionnaire is to ask you some questions about our class especially those classes we had where I used cultural practices and activities to teach our lesson. I like to remind you that all information you provide will be kept confidential and your identity will not be disclosed in any part of the final report.

The research study deals with selective use of cultural practices and activities in teaching pre-service teachers course MS 210-Math for Elementary Teachers here at College of Micronesia-FSM, Chuuk Campus.

I would prefer that you use English in answering the questions but please feel free to answer in your own language if it is more comfortable for you.

1. What do you think about the classes we had using cultural practices and activities? Explain.
2. Which among the lessons that were taught using cultural practices and activities stood out for you? Explain why?
  - a. What part of the lesson did you enjoy most? Dislike most?
  - b. What part of the lesson do you think should be changed if any?
3. Are there any lessons that were taught using cultural practices and activities that we did not accomplish the student's learning outcome?
  - a. What were these lessons?
  - b. How can we modify the lesson so that we will be able to accomplish our student's learning outcomes?
4. What were the difficulties you encountered in the math lessons that were taught using cultural practices and activities?
  - a. Did you have the same difficulties in the math lessons that were taught using the textbook and the exercises in the textbook?
5. What challenges did you meet in developing lessons using cultural practices and activities?
  - a. What should have we done in class to meet these challenges?

6. What is overall impression about using cultural practices and activities in teaching mathematics?

- a. What impact, if any, do you feel this has on your learning mathematics?
- b. When you become a teacher, are you going to implement some of the lessons we did in class? Which ones and why?
- c. Are there parts of the lessons you are going to change when you implement them? What are they and why?

7. What impact, if any, do you feel these lessons taught using cultural practices and activities has on your preparation as a classroom teacher? Explain.

*Appendix E: QUESTION GUIDE FOR JOURNAL ENTRY*

(To be announced on the first day of instruction and printed copy will be given for each student. All students are required to have a class journal.)

"Congratulations for making it to MS/Ed 210a - Math for Elementary Teachers. Like in your other required education courses, you will be asked to have a journal for every lesson in class that was taught using cultural practices and activities. Your journal will reflect your personal thoughts about your experiences in this course. The questions below will guide you in your journal entry but please feel free to write additional information about the class that you think is relevant to your learning."

**Question Guide:**

1. How you feel about our lesson today.
2. What part of the lesson did you enjoy most and why?
3. What part of the lesson did you dislike most and why?
4. Did the lesson accomplish the "student-learning outcome"? Explain?
5. Was the cultural practice and activity appropriate for the lesson? Explain.

Kinisou Chapur,  
Danilo A. Mamangon

*Appendix F: QUESTION GUIDE FOR NARRATIVE STORY*

"May I express my sincere thanks to you for your full participation in this research project. The end of the research project has come and I want to write your story about your reflections and perceptions on your experiences on going through the MS/ED 210 course lessons that was taught using cultural practices and activities. The questions below are given to guide in writing your story but please feel free to write your own ideas about your experiences. I encourage you to write in English, however, if there are times that you feel it necessary, please feel free to use your own language. The story you will share will be kept strictly confidential and you will not be identified in any part of my report. I will share to you my report so that you will be aware of how the story you shared was used."

1. Why did you agree to participate in this education research project?
2. What were your initial impressions about the research project?
3. Describe your reactions to the lessons taught using cultural practices and activities.
  - a. Did you enjoy the lessons? Why or why not?
  - b. Did the lesson motivate to you to fully engage yourself to the class activity?
  - c. Were your classmates also fully engaged in the class activity?
  - d. Was the cultural practice and activity helpful in your understanding of the math lesson being taught?
4. Were you comfortable in learning mathematics through cultural practices and activities? What were the difficulties you encountered with the lesson taught using cultural practices and activities?
5. What impact, if any, do you feel this research project has on your impression about using cultural practices and activities in teaching mathematics?
6. What impact, if any, do you feel this research project has on your future career as elementary teacher?

"Kinisou Chapur! I will get in touch so that we could further discuss your story on your experiences in our class."

With sincere respect,  
Danilo A. Mamangon

*Appendix G: MS/Ed 210 COURSE OUTLINE*

**College of Micronesia-FSM**

PO Box 159 Kolonia

Pohnpei, FM 96941

**COURSE OUTLINE**

Math for Teachers I

Division of Natural Sciences and Mathematics MS/ED 210a

Course Title

Department & Number

**Course Description:**

Math for Teachers I and II are each one-semester courses. Math for Teachers I, MS/ED 210a is the first semester course. It is designed to provide the students with a broad understanding of basic mathematic concepts. The topics include: problem solving strategies, the numeration system and its operations, number theory, integers, fractions, decimals, exponents, and real numbers.

This course places emphasizes on the use of models, diagrams, manipulatives, applications, problem solving, and reasoning. Through the use of the hands-on activities in this course, students will gain and enhance their conceptual knowledge of arithmetic from counting to algebra. These are especially geared to provide ideas, models, knowledge, and standards that are necessary for successful teaching of mathematics to elementary and middle school children.

**Course Prepared by:** Yen-ti Verg-in

**State:** National Campus

|                   | Hours per week  |   | No. of week     |   | Total Hours     | Semester          |
|-------------------|-----------------|---|-----------------|---|-----------------|-------------------|
| Credits           |                 |   |                 |   |                 |                   |
| <b>Lecture</b>    | <u>3</u>        | x | <u>16</u>       | x | <u>48</u>       | = <u>3</u>        |
| <b>Laboratory</b> | <u>        </u> | x | <u>        </u> | = | <u>        </u> | = <u>        </u> |
| <b>Workshop</b>   | <u>        </u> | x | <u>        </u> | x | <u>        </u> | = <u>        </u> |

**Purpose of Course:**

Degree Requirement         x          
Degree Elective           
Certificate           
Other         x        

**Prerequisites:**

ESL 089 and a grade of "C" or better in MS 098.

\_\_\_\_\_  
Signature, Chairperson, Curriculum Committee  
Committee

\_\_\_\_\_  
Date Approved by

\_\_\_\_\_  
Signature, President, COM-FSM

\_\_\_\_\_  
Date Approved by President

## Course Description:

Math for Teachers I and II are each one-semester courses. Math for Teachers I, MS/ED 210a is the first semester course. It is designed to provide the students with a broad understanding of basic mathematic concepts. The topics include: problem solving strategies, the numeration system and its operations, number theory, integers, fractions, decimals, exponents, and real numbers.

This course places emphasizes on the use of models, diagrams, manipulatives, applications, problem solving, and reasoning. Through the use of the hands-on activities in this course, students will gain and enhance their conceptual knowledge of arithmetic from counting to algebra. These are especially geared to provide ideas, models, knowledge, and standards that are necessary for successful teaching of mathematics to elementary and middle school children.

This course is developed in accordance with “The Pacific Standards for Excellence in Mathematics.” It follows the National Councils of Teachers of Mathematics’ guidelines closely, and it is designed to fit in with our new certification standards.

The goals for this course are:

- To involve the student in thinking about mathematical ideas.
- To develop the student’s ability to convey mathematical thoughts and ideas clearly and concisely to others in both oral and written form.
- To expose the student to mathematical systems and to mathematical problem solving.
- To cultivate in the student an appreciation for mathematics.
- To use problem-solving approaches to investigate and understand mathematical content.
- To familiarize students with the math content of the elementary school curriculum.

### I. Mathematics/Education Program Outcomes

#### Students will be able to:

- A. **define** arithmetic and algebraic concepts
- B. **calculate** arithmetic and algebraic *using appropriate technology.*
- C. **estimate** arithmetic and algebraic solutions
- D. **solve** arithmetic and algebraic problems *using appropriate technology.*
- E. **represent** mathematical information numerically, symbolically, graphically, verbally, and visually *using appropriate technology.*
- F. **develop** mathematical models such as formulas, functions, graphs, and tables *using appropriate technology.*
- G. **interpret** mathematical models such as formulas, functions, graphs, tables, and schematics, drawing conclusions and making inferences based on those models.

- H. **explore** mathematical systems *utilizing rich experiences that encourage independent, nontrivial, constructive exploration in mathematics.*
- I. **communicate** mathematical thoughts and ideas clearly and concisely to others in the oral and written form.
- J. **demonstrate** a mastery of the content of the elementary school curriculum.

## II. Course Objectives for MS/Ed 210a:

### A. General Objectives:

1. The students will be able to use different strategies to solve word problems, and reflect and clarify their own thinking about mathematical ideas and situations. (Solve and communicate.)
2. The students will be able to demonstrate competence in understanding numbers, ways of representing numbers, and relationship among numbers, the numeration system and its operations. (Define, calculate, estimate, solve, and communicate.)
3. The students will be able to identify what number theory is and utilize it in problem solving situations. (Define, calculate, solve, and communicate.)
4. The students will be able to understand the concept of fractions and decimals, and the interrelationship between them. (Define, calculate, estimate, solve, and communicate.)

### B. Specific Student Learning Outcomes:

1. The students will be able to use different strategies to solve word problems, and reflect and clarify their own thinking about mathematical ideas and situations. (Solve and communicate.)

The student will be able to...

1a. apply George Polya's four steps problem solving technique: understand the problem, devise a plan, carry out the plan, and look back and check.

1b. select and apply a variety of strategies to solve multi-step problems as: making a table, chart or list, drawing pictures, making a model, working backwards, guessing and checking, using algebraic expression, and comparing with previous experience.



1c. apply algebraic methods to solve a variety of real-world and mathematical problems.

1d. identify certain patterns either in numbers, symbols, manipulatives, and natural phenomena to solve word problems.

1e. describe, extend, analyze, and create a wide variety of patterns.

1f. select appropriate tools for computation and estimation.

1g. communicate the mathematical thoughts, ideas, and solutions clearly and concisely to others in the oral and written forms.

2. The students will be able to demonstrate competence in understanding numbers, ways of representing numbers, and relationship among numbers, numeration system, and its operations. (Define, calculate, estimate, solve, and communicate.)

The student will be able to...

2a. develop number sense for whole numbers and their four fundamental operations.

2b. model and explain the processes of addition, subtraction, multiplication, and division and describe the relationship between them.

2c. recognize, describe, and use properties of the real number system.

2d. apply mental calculation strategies to compute and make reasonable estimates.

2e. begin to build an understanding of operations with integers by using chip model and number line model to represent positive and negative numbers

3. The students will be able to identify what number theory is and utilize it in problem solving situations. (Define, calculate, solve, and communicate.)

The student will be able to...

3a. understand and use the basic divisibility rules: The divisibility of 2's, 3's, 4's, 5's, 6's, 9's and 10's.

- 3b. define and explain the difference between Least Common Multiples and Greatest Common Factors and find LCM and GCF.
- 3c. define and identify prime and composite numbers.
- 3d. develop and apply number theory concepts (e.g. primes and composite, factors and multiples) in real-world and mathematical problem situations.
- 3e. solve word problems involving LCM or GCF, and explain the solution clearly and concisely to others in the oral and written forms.
- 4. The student will be able to understand the concept of fractions, decimals, and the interrelationship between them. (Define, calculate, estimate, solve, and communicate.)

The student will be able to...

- 4a. define the meaning of fractions and identify, model, and label simple fractions.
- 4b. describe and define the fractions as the part-to-whole concept, the division concept, and the ratio concept.
- 4c. compare fractions and decimals efficiently, and find their appropriate location on a number line.
- 4d. describe and model the relationship of fractions and decimals, and develop and use order relations for whole numbers, fractions, decimals, integers, and rational numbers.
- 4e. extend their understanding of whole number operations to fractions, decimals, integers, and rational numbers.
- 4f. solve word problems with fractions and decimals. Explain their solution clearly and concisely to others in the oral and written forms.

**III. Pre-requisite:** MS 098 or higher with a “C” or better.

**IV. Textbook:** Mathematics for Elementary Teachers, Volume 1 Numbers and Operations, by Sybilla Beckmann, Copyright © 2003, Person Education, Inc. ISBN 0-321-12980-6

**V. Required Course Materials:** None

**VI. Reference Materials:**

Mathematics for Elementary School Teachers: Explorations, by Tom Bassarear.

Mathematics for Elementary Teachers by Albert B. Bennett, Jr. and L. Ted Nelson.

**VII. Instructional Costs:** a variety of inexpensive materials will be needed for the hands-on based activities, and will be provided by the Math/Science and Education Divisions.

**VIII. Methods of Instruction:** Activities and explorations are used as starting points, followed by discussions or lectures based on extensions of the ideas raised in the investigations.

**IX. Evaluation and Assessment:** Students will be frequently given both individual and small-groups based assignments and quizzes. Several exams will be spread over the term. A portfolio due at the end of the semester will be required. Scoring rubrics will be used to evaluate the portfolio. All of these methods will be applied to assess student's understanding and competence of the course materials.

**X. Credit by Examinations:** None.

**XI. Attendance Policy:** As per College policy in the current catalog.

**XII. Academic Honesty Policy:** As per College policy in the current catalog.

*Appendix H: ACTIVITY PLAN FOR TEACHING PATTERNS*

**College of Micronesia - FSM, Chuuk Campus  
MS/Ed 210a - Math for Elementary Teachers**

Group No. \_\_\_\_\_

Group Members: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**PATTERNS with "Mwaramwar"**

**ACTIVITY 1: Making Mwaramwar**

Using the materials assigned to each of your group members, construct two Chuukese traditional lei. Assign a recorder for your group to write the procedure of making the traditional lei as actually done by your group. The recorder may write the procedure in paragraph form or in list form.

**ACTIVITY 2: Making the Table**

Fill the table provided for your group with the name of the flowers you used or using the colors of the flowers you used as they are ordered in the traditional lei that you made. You may use the either the Chuukese name or the English name for the flowers you used in making the lei or combination of both Chuukese and English. Make sure to be consistent in the name of the flowers you record in your table.

Example 1: Using Colors

|       |     |     |        |        |     |
|-------|-----|-----|--------|--------|-----|
| N     | 1   | 2   | 3      | 4      | ... |
| Color | Red | Red | Yellow | Yellow | ... |

Example 2: Using Name of Flowers

|        |      |      |         |         |     |
|--------|------|------|---------|---------|-----|
| N      | 1    | 2    | 3       | 4       | ... |
| Flower | rose | rose | pwanang | pwanang | ... |

### **ACTIVITY 3: Recognizing Patterns in the Traditional Lei**

As a group, discuss and observe your table and identify certain intervals in your table that your group believes to be a pattern. Describe the pattern that you recognized.

Based on your group's discussion and observation, explain your understanding about what pattern is.

Appendix I: QUOTES-APRILYN

Using regrouping, not borrowing! I always was confused with subtraction when we borrow one, but we get ten instead. The teachers never make clear about this. So, I think that if I teach

I extremely feel excited and motivated about the lesson. I finally earn an opportunity to experience how to teach a lesson out of cultural activities. The lesson enlightens me

that using cultural activities in class is indeed fun and effective.

I am concerned, I never remembered touching into this lesson while I was in elementary. I can finally say that I am

At first, I was immensely eager to find out what the intention of the weaving the leis and if it is a relevant source to mathematics. But they

cultural activities because it is effectively a reliable source to acquire math.

through cultural activities, I can still learn math effectively. I also believe that this activity would assist the students to increase their learning skills and creativity and will serve as good approach to teaching mathematics.

they understood and applied what was asked of them. I observed almost everyone from the class as they fixed their assigned worksheet No. 2. Everyone seemed to understand what to do. This means, we are progressively able to recognize patterns.

activities and practices in class, and prove it that it is an enhanced way to learn and teach mathematics. Second it is an interesting

own cultural effects. Last but not the least, I want the future children to view their culture as something valuable. Also, I

at least they were ~~order~~ introduced and they will be able to learn effectively and successfully.

the feeling of curiosity and suspicions, at the same time, eagerness was pushing me forward to actually witness and experience the teaching techniques through cultural practices and activities.

myself this question "Is this even possible, teaching using cultural practice?" Nothing seemed to

making of leis the most. It was my first-time ever experience to observe and learn math out of my own cultural activities. I was excited about finding patterns on the woven leis. I

Yes, I was motivated to learn math through cultural activities and practice. The lesson encouraged me to fully engage myself into the class activities and discussion. It helped developed my thinking skills and interest in pursuing the teaching methods via the use of cultural approaches. My first impression about this course was to struggle with difficult

because all of the lessons eventually gave me the determination that it is much easier to teach and learn math through cultural activity and practice.

They actually participated in class discussion. They were also delighted to have gone through the experience of learning math through cultural activities. When the first cultural lesson was introduced, they were all in a mood where they couldn't able to wait and witness the actual lesson they will learn from the cultural activities. When we presented the fishing torch to the whole class, everyone was astonished. They asked questions, they made comments and suggestions, and shared what they know. I was at the back observed

math effectually. I finally realized that through cultural activities, math is much easier and understandable for each of the students to comprehend and apply math lessons. For example, I think it is easier to add and subtract using "regrouping". In elementary, I was taught that there is this thing called "borrowing" in subtraction. I noticed it doesn't make any sense, but I never accommodated a better explanation of this. So when our instructor presented the "addition and subtraction using regrouping", I eventually found the answer or explanation I

have been looking for. Indeed, the cultural activities helped me understand things that I failed to understand.

cultural values and practices of the other parts of Chuuk. Additionally, at some aspects, I did not give any attention to some cultural practices as something matter, because of this project,

I realized that my culture is very essential and it's even fit to learning other things. I felt

the torch fishing presentation and the additional work. I found it hard, because at one point, I did not know what torch fishing is, and how it is used and its cultural importance. I was totally unfamiliar with this. But having some people to gather some information from, I was able to

At first I thought, this project seemed impossible. As I moved through each of the cultural activities, my views began to gradually change. I found out that it is easier and more effective to learn and teach math through the approach of cultural activities and practices. I've possessed a positive impact toward the use of cultural activities and practices in teaching math. I declared that it is best to learn and teach math using cultural activities and practices.

I used to take pleasure in math. But as time flew by, I realized that I do not have the potential to teach math. I do not math, but I do not know how to explain. At this point, I reorganize my

a different field, not math anymore. Now, my plan has changed again. Taking part in this research project has enabled me to be knowledgeable and skillful in teaching. Experiencing this kind of teaching technique, I believe that if I ever earned the opportunity of teach in the future, I will be an outstanding and successful teacher influencing and teaching elementary students through cultural activities and practices.

delivery of the lesson nor the process of the lesson. The difficulty that I was faced with is the lack access or knowledge about cultures of the other parts of Chuuk. Also, I had I had difficulty looking for the traditional word for the cultural activities, spelling or naming the counting numbers. Also, I was unable to explain

## Appendix J: QUOTES-CHONFAN

I don't know how cultural practices are used especially in math.

were great. The cultural practices and activities made the lessons more clearer and understandable.

Honestly I did not know what I was getting myself into but I'm glad I agreed to do this project. Have you ever done something without knowing what's in it for you? Well this was my case; I threw myself into doing this project hoping for something good that I can benefit something out of it. I agreed to do this project because I hate expected us to memorize each numbers and their values. It was very discouraging and boring. Now that I have completed the project I am confident to say that I am ready to teach elementary math. The project was not easy but it was fun and interesting and that's what kept me going. I'm glad I made the right decision on agreeing to do this project.

found out that the leis we were making actually had patterns. I think it was the easiest way to identify each type of pattern. The leis we made represented each type of pattern. Some of us made leis that represented the continuing pattern while some of us made leis that turned out to be repeating patterns. We did not realize that we were actually making patterns until our respected instructor, Danie Mamangon, told us to observe the leis we made.

I was very surprised about the lessons being taught using cultural practices and activities. I did not know that we can actually solve and develop math lessons through or by using cultural practices and activities. For instance, when Danie Mamangon making them for the fun of it. We actually learned pattern through making leis. We learned how to identify whether it is a continuing or repeating pattern. I was also surprised when I learned that the Hindu- Arabic numeral system is almost or close to the Chuukese counting system.

about torch fishing. I learned math and my culture. This is a good way to teach the culture to the young generations. It is important for us Chuukese to keep our culture


teaching math in the future because I was always bad in math. I would not want my

in elementary but this time I'm learning math the right way. I have to say that I



This research project was very helpful to me. It made the lessons easier and most of all understandable. Without the cultural practices I don't think I will ever teach mathematics. But most importantly the research project really prepared me to become or to be able to teach math to elementary students. I'm just really thankful and

of the lesson. What is there to dislike about the lesson when students are not only learning how to add and subtract, but they are also learning the Chinese culture.

explain in the previous question. If a teacher uses acorns or figures instead of just adding numbers themselves it would be a lot more easier for students to add. for example:  $20 + 7 \rightarrow$    $+ 8000 \rightarrow$  Here elementary students would be able to see the figures and they would count them and there they would know what 20 is and be able to understand.

I actually used to go torch fishing when I was young. I never thought I can use the activity to do math.

Numerical System. I thought the U.S. came up with the system. The lesson was very

I don't like the tenths, hundredths, etc. numbers.

I enjoyed it because it is almost like playing with toys and learning at the same time. When you make leis we will see that

## Appendix K: QUOTES-FILEMINO

mind. I want to find out all kinds of cultural practice that would match which mathematics lessons. Then I would list them down and file them for future use. For

The problem is, if I'm the only one using cultural practices in math lesson, other teachers (higher grade levels) need to do the same thing. If I was to teach the third grade level, 8th grade teacher needs to be teaching math using culture as well. If third graders really understand the lesson, when they move up to the levels above (including high schools), it's possible that they may lose interest in math if it's not taught with culture in the upper grades. That's why I say DOE, Chuuk, should make implement culture into the curriculum where it would be used to teach the lesson. That means all teacher

of met each one individually. The main problem was our little knowledge of the Chuukese culture (see #4).

teaching mathematics? I think Chuuk State Department of Education should make it a must that culture should be used in teaching lessons in the classrooms, especially with mathematics. I think somewhere in the Constitution (National and State), culture is supposed to be enforced. They really need to make that into a law and apply it. Why? Because ~~the~~

If we use cultural practices to teach math (for example), children would understand the lesson better and would be motivated in learning more about their own culture.

using cultural practices and activities? I don't think the lessons were difficult at all. I think they were made easier by using cultural activities. The only difficulty I had was trying to come up with cultural names for number grouping.

difference was that I did not teach math using the Chuukese culture. It was strictly Chuukese

When I realized the many ways that you can use any cultural practice to solve math problems, I became excited and wanted to learn more. After perhaps the second set of instructions, I sort of connected other cultural practices with solving math; especially that of addition & subtraction, multiplication & division. For example, during big feasts each

After the first lesson was given (making of the mwaramwar), I became excited and wanted to learn more about other cultural practices that we would create a mathematic lesson out of. The math lesson that was taught with the lei-making was number patterns in which the students identified what color of which particular flower would show up at number one hundred. I thought it was exciting because my initial

thinking, "Wow, this is easy", so it made me become motivated to see other cultural

As I've said earlier, I thought learning the math by performing each cultural practice really helped to open my eyes to see how the problem was done. So yes, I was comfortable

Now that I am armed with my "new weapon" I am ready to go out and "set the world of schooling on fire".

It'll definitely make young kids learn more and know more when they can relate to something they already know.

Community will <sup>actually</sup> have a part, either from home or at school. are known to only a few people (Danger of becoming extinct)

enjoyed it because I knew what I was doing and also because it made me feel good to see students getting motivated doing and building stuff outside the classroom.

and activities? Explain why. At first it may seem difficult with those who haven't had any experience relating math w/ cultural aspects. But I think

means to say that the teacher must be creative in giving out the lesson so that it's fun and at the same time it's productive.

Adding eleven, thirteen, and seventeen was made more clearer when we took groups of the ten's ( $10 + 3$ ,  $10 + 1$ ,  $10 + 7$ ...) regrouped the left-overs ( $3 + 7 + 1$ ), and were able to come up with ~~four~~ "faaf me efou" (forty bunches (10) of coconuts and one).

visualize regrouping. It would stick in their heads when they actually get their hands on the materials for the lesson.

can also represent the decimal point. Mostly though I think making us aware of our Chinese counting numbers helped me to recognize the Hindu-Arabic better; therefore, the learning

dialect) because I am sure the teachers out there are sticking to the curriculum alone. I don't think they're using the cultural activities to teach the subject. They're strictly textbook type. So I'm on a mission now. I will follow the curriculum my way. Because I think if the students are interested in something, the lesson taught will stick. That's what I believe.

I think it's really amazing how you can make a lei and form an equation out of that. So yes, I think I enjoy

there's always a pattern involved without the ~~making~~ maker being conscious of it. But when you actually explain how a pattern was formed by the lei, I think students find it easier to understand because they're the ones who made the leis.



Appendix L: QUOTES-MARIVIC

am not ready I can see just from my class that the class I will teach in elementary will enjoy my teachings based on cultural practices and activities. The fun that I had by learning

The impact that I feel is eagerness. I feel so eager in wanting to graduate soon so that all the great ideas I have in my head, I just wanna pour them all out to my students to learn all these incredible new ideas of teaching math lessons using cultural practices and activities

not just get on my nerves. Sometimes I get, just can't stand word problems that is why

we've learn in class. I doubt the cultural activities to have any good impact on the lessons from class. But as soon as we go over all the activities I was stunned on how it really did work.

I did enjoy all the lessons. They inspire me

Yes it did! For one thing, the lessons that had been taught by cultural practices or lessons from class are much more fun to enjoy. They motivate

We will find a way of learning more than just repeating or parrot the lessons from a textbook. It is also

practices & activities. It will be like a new edition of the textbook that we are all require

yet ready. But the impacts that has on me to be prepared is when I stand in front of class the day we ~~present~~ perform our presentation on the fishing torch, My ~~being~~ nervous case and I felt like I am already a teacher teaching my students. And

perform in class. I think that if we keep on using on studying this cultural practices and activities, our knowledge in math will improve.

I'm impress on how we mix up our modern lesson to the ~~old~~ our cultural practices. We do the lessons in chunks and we explain it in a modern way. I really enjoy it. It makes me to see clearly the lesson that had been taught.

Yes, the lesson that we try to express through the cultural practices that we use is similar to the student-learning outcome that we also learn during class.

example, "Rue me Ru = 22". I felt confuse because I grew up learning that but nobody tell me why we use it. Some of my classmates says that

It is appropriate because the lesson we learn in class and the cultural practice or activities are connected and we understand the lesson very well. In fact, we've got many "Oh" when we learn the new lesson using cultural practices and activities.

## Appendix M: QUOTES-MELVA

the lesson just because I want the students to understand the lesson in other method not in cultural practices because I don't know how to teach in cultural practices I want in my own method the way the students understand.

Sometimes they really confuse of that. I think some of the teachers, they don't know how to use it. That's why I think it is difficult to teachers and students.

and activities to teach mathematics lessons and concepts? My opinion it is not good for that using cultural to teach mathematics lessons, because our cultural here is more difficult for others to understand. Chukkes Cultural

in my grade level from elementary until now, no one should be used cultural practices and activities to teach lessons.

yes I feel a lot that I have learning in mathematics using cultural practices.

I enjoy most just like I have fun. But when we do our lesson without cultural practices that's the way I really don't like.

How you feel about our lesson today. I feel good about our lessons, because I learn a lot of things like, how to make torch, how

I like or I enjoy when we find the average because it easy by adding the numbers together.

numbers in addition, because I think that's the easiest way to learn to counting numbers, both.

I feel interesting, like I'm happy and really like. I like the way I learn or the way my teacher teach us to identify if it's any pattern on our lei if it's repeating or growing patterns.

What part of the lesson did you enjoy most and why?  
I really enjoy most of the identify patterns on our  
leaves because it's really easy to just say the name of  
the flowers and we know if it's growing or repeating  
the flowers and their name.

can help my grade to be going up if I participate in his class whether my grade is bad but I'd  
like to be his participant student in this semester and in this new idea of using cultural  
activity to teach math if it would make a change in the nearer future I think it kind of easy to  
the our new generation to learn in this new curriculum if it we using in the future I think it  
surprise some one because this is the new way to study in math using cultural practices in  
the nearer future. It kind of helping way I think this is the easiest way to help the kids in the

looking for, when we begin to bring something? I'm glad it started this project, how the  
cultural activities fit into mathematics? If there are so many different kinds of cultural  
activities. How would he put the act when we practice different culture in here which of  
this culture would perfect for this project? Would this project help to develop the  
mathematics skills for the chuukese students? I was felt excited when the displaying in

them they didn't know how to use torch to go fishing, but some of them they share their  
kind of different using torch to go fishing they share with us in class that they key to

in your mind, it can gave us some tools on craft, someone it can change their mind to  
involve to become teacher in the future. Because, if someone doesn't like to become  
teacher but if they learn in this way of learning, it can change their mind to become  
teacher in the future, something in our education development it can be change from



Appendix N: QUOTES-SYLFRAN

This research program has changed the way that I think and once felt towards math. It gave me a glimpse of what math really was about. Another way that it

an English or Social Studies teacher. Now that I have learned this type of teaching method, I can now say that teaching math will not be a problem.

Yes, if not all the lessons but all these cultural activities that were going about in our class was something that fully motivated me to keep coming to class. It was like taking our history and heritage only better, with a new mix MATH! I just loved the lessons so much that I did not even want to miss the class. Though I felt sick at sometimes, still I managed to come to the class and have fun. Especially the way that our teacher gives out the

class. Wanting to learn something new about the way our culture is and turning it into a new way of learning mathematics is something that I did

ways that the torch was made. Some were very helpful to help us in what we did not present to the class. But some of them just kept laughing and

like "now what would a math class be doing bringing needles and threats to class when this is not a sewing class? And what would flowers have to do with math,

and decided to take this once in a life-time opportunity so that I would look back

I think it was wonderful! I don't know how Mr. Davis pulled it off but he's just so brilliant! The lessons were fun and creative. I like the activities and lessons taught for

know very well how to make legs, this class made it fun to learn instead of making it difficult.

In my own opinion, based on my experience as an islander, it's a really good idea. It's where the students in a classroom get a clear picture of what it is that you are actually talking about. Well unless they grow up on Guam.

them, but I think they were not focused on the explanations.

Standing in front of the class was the most terrifying thing. Well since I don't usually like talking in front of people, but it's good practice since I am supposed to be a teacher.

to their multiplication problems. It is also a concept that will strengthen their addition and subtraction abilities.

Yes, it was quite something that was not too hard to understand, well except the part where we had to name the counting baskets.

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