

A COMMUNITY APPROACH TO INTRODUCING YOUNG CHILDREN TO EARLY  
MATHEMATICS: A STUDY OF KOSRAEAN PRESCHOOL CHILDREN IN THEIR  
HOMES

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## ABSTRACT

This study seeks to determine the impact of parents at home on the development of mathematical concepts among young children of preschool age. This study also looks into the influences of other members of the family, relatives, and the community in the mathematics development of the child-research participant. It focuses on the influences of parents and other members of the family to their children's mathematics learning at home or in the community

The study seeks to answer the following questions:

1. How do parents influence preschool children's mathematics learning?
2. How do other members of the family and people in the community contribute to the mathematics development of preschool children?

To seek answers to these questions, case studies of families were developed from focus group meetings, interviews with parents, observations of children at their homes, and parents' diaries of children activities, which were kept in the home. Findings suggest that the various environments; although they are all island environments, differently influence both the development of mathematical language and the range of mathematics activities in the homes and community in which each child lives. The nuclear family influences, the extended family influences, and neighbors' influences contributed to the mathematics development of each child. The history of Kosrae and the culture and traditions are indirect influences that also contribute to the mathematics learning or preschool children. Information about the knowledge and skills that the children acquire at home may be useful to educators and allow them to improve the learning of mathematics in children's first years in school.

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## INTRODUCTION AND LITERATURE REVIEW

### Indirect Influences on Preschool Mathematics Learning

#### History and Social Environment of Kosrae

Kosrae is the easternmost state of the Federated States of Micronesia (FSM). Kosrae is a high island of 109 square kilometers surrounded by a fringing reef. Shorelines are partly mangroves and sand beaches. Around the coastal areas are rugged dwelling places, where most villages are situated. Growing upland is a biodiversity of native rainforest vegetation. Kosrae Island is very humid and seasons are hardly distinguishable.

The history and sociocultural environment of Kosrae are potentially sources of influence on the development of mathematics knowledge. Stigler and Baranes stated in their study of culture and mathematics that, “Today we engage in cross-cultural studies of mathematical thinking, not to learn about primitives, but to learn about ourselves (Stigler & Baranes, 1988-1989, p. 254).”

Stigler and Baranes also noted that:

Wittgenstein in his philosophy of mathematics questioned the notion that mathematics is a system that exists apart from the practice of doing mathematics. Instead he saw mathematics as social in nature and inseparable from the social realm in which it is used (p. 257).

The history of the early people of Kosrae unfolds parts of the traditions and customs in our culture. Some activities in our culture are actually not our original customs and traditions but are thought to be part of our culture, however, we are aware of the fact that these activities have been borrowed and incorporated into our traditions and culture.

With the influences of the different colonial occupations in Kosrae, some knowledge and skills have been incorporated into our school curriculum. These colonial changes remained in our culture as if they were originally the culture and traditions of our early ancestors. These activities should be researched and analyzed to describe the true Kosraean culture and traditions. However,

to relate these changes to the mathematical development of our culture, as Stigler and Baranes (1988-1989) mentioned,

We take the position that mathematics is not a universal, formal domain of knowledge waiting to be discovered, but rather an assemblage of culturally constructed symbolic representations and procedures for manipulating these representations (p. 258).

Kaomea (2003) mentions that comprehensive interpretive analyses should progress beyond the study of surface appearance, and should include the persistent excavation of perspectives and circumstances that have been buried, written over, or erased (p. 16). A lot of words are borrowed words and are adopted for use in the community and thought of as relevant to our culture, and yet they are not. This research takes into consideration the history of our island, and to really identify the kind of mathematics that were indirectly learned in and around the homes.

Over the years the social environment changes; therefore, different families may react differently to the social changes. Although Kosrae lost its monarchical systems along with some social activities as resulted from the arrival of the missionaries, whalers, and traders in the early 1800's, most of the cultural values remain and are still being practiced.

The indigenous culture in Kosrae is Kosraean is distinguishable from other islands in the Federated States of Micronesia (FSM). At the time of initial contact with the West, the black-haired, brown-skinned people who came to be known as Kosraeans were shorter and more delicately built. In aboriginal times, there were crafts specialists, including cooks, *fahfah* makers, kava makers and servers, nannies, canoe builders, and fishers. Gender also determines the allocation of tasks: (Peoples, 1996). "The Kosraean men were all farmers, and in addition, specialized in one of four trades: fishing, cooking, house building, or canoe-making, with a son generally following the same line of work as his father" (Buck, 2005, p.14). Women were weavers of nets, baskets, belts, and clothing while men were cultivators, builders, cooks, and makers of earth ovens (Peoples, James. Encyclopedia of World Cultures. 1996. Encyclopedia.com) Young children imitate parents' roles as they play with peers either in their homes or around the neighborhood.

The social environment of Kosrae has been changing since the arrivals of the whalers, traders, and the missionaries in the 1800's. During this period (1830-1880) epidemics of influenza and venereal disease swept the island and the population plummeted from 6,000 to 200 individuals (Ritter & Ritter 1981). Kosrae was under the influence of three different colonial powers: Germany, Japan, and the United States. During this period, the population increased from a low of 200 to 6,616 (2010 Census). In 1978, Kosrae joined Pohnpei, Chuuk and Yap to become the Federated States of Micronesia. Kosrae State consists of four municipalities: Utwe, Malem, Tafunsak, and Lelu. The church plays an important role in Kosraean society, and many of the rigid moral standards set by the first missionaries to Kosrae still persist. On Sundays, most Kosraeans spend the better part of the day in church; activities such as cooking and fishing are prohibited on the Sabbath (MICRONESICA: A Journal of the University of Guam, vol. 25, No. 1, June 1992, pp. 2-4). Due to the large average family size and the fact that relatives usually live close by, young children grow up in a nurturing atmosphere. Infants are coddled by young and old alike. Although there is variation, physical punishment like spanking and hitting with brooms occurs from the age of 2, and verbal scolding is common. Children begin to perform simple household tasks such as sweeping and fetching as early as 3 or 4. Girls help their mothers extensively with washing and other chores once they reach the age of 9 or 10. Boys accompany their fathers and older brothers to gardens at similarly young ages. (Peoples, James. Encyclopedia of World Cultures, 1996. [www.encyclopedia.com](http://www.encyclopedia.com))

Although more Kosraeans are in wage-earning jobs, agriculture and fishing continue to provide the primary means of subsistence. Fishing in particular provides a dependable supply of protein. With the exception of throw-netting and spearfishing, which are men's fishing activities; all inshore fishing is done by women. The mathematics concepts and skills from these activities might be many, but have yet to be researched.

One factor influencing young children's learning is the way in which they are reared. As defined by Wondra (n.d.), child rearing practice is the generally accepted way in which children in a society are raised towards philosophical and social standards. Cultural ways for rearing a child have changed over the years. As a child grows up, he learns things mostly from patrilineal families and sometimes would pick up some knowledge and skills from matrilineal families, especially from the visits to the mother's family. The extended family plays an important role in

both the cognitive and physical development of the child. Often times the members of the extended family are brothers and unmarried sisters of a child's father, the grandparents, and nephews and nieces of the child, and of course parents and the siblings of the child, Outside the house and around the neighborhood, the child would be allowed to play with peers and friends and may learn some mathematics from the interactions with these kids. The child does not get to school yet until he gets five or six years of age; however, he goes to church, funerals, weddings, and other community activities, where he builds more on his language vocabularies and gains more knowledge and skills including mathematics knowledge and skills.

Diverse cultural backgrounds reflect different child rearing practices (Wondra, n.d.). With the introduction of the electronic technologies of video games, computers, and television, parents spend lesser time with their children. And the consequences of these result in the shifts from the indigenous ways of using and learning mathematics to the introduced western ways of learning. The more we leave our children to learn from these electronic technologies, the more our cultural child-rearing knowledge diminishes. Nowadays we are trained to adopt Western ways of rearing children.

We are trained to adopt Western models of parenting, and yet these Western models of child-rearing are devaluing and supplanting indigenous child rearing knowledge, and undermining indigenous families' confidence in our ability to successfully rear, nurture, and educate our young children (Kaomea, 2005, p. 79).

Kaomea (2005) also mentions that time and time again various early childhood and social services view indigenous parents and families, and our influence on our young children, as a "problem"- a detriment to be compensated for rather than a source of strength and knowledge to be supported and built upon. We are blamed for the poor performance of our children in school, and we are told to send our children to school for them to learn mathematics better.

This faulty and potentially dangerous line of reasoning fails to acknowledge how current problems read back on the past and leads to the construction of indigenous parents and families as "always already" failing. "Always" in the sense of a dehistoricized notion of failing at parenting, and "already" in the sense that even before an indigenous child is

born, its expectant mother is “already” constructed as failing, and her child, consequently, as at risk (Kaomea, 2005, p. 91).

Mothers spend less time with their children and went from breast-feeding to using bottles.

### Story Telling

Story telling has been and continues to be an integral and culturally preferred method of imparting knowledge in many indigenous societies (Bishop & Glynn, 2003). At night, the children would lay their heads on their mother or their father’s arms, and listen as bed time stories were being told. Sometimes the children themselves would lie in the house and each take turns telling a story. Popular stories are often legends of war between the common people and rulers of ancient monarchs. “Indigenous oral narratives were used to teach cultural values, transmit historical information, perpetuate family genealogies, and impart knowledge about cultural customs and traditions” (Kaomea, p. 79) down the generations. These oral indigenous narratives should be studied in order that mathematics in the narratives can be identified and adopted in formal mathematics learning. According to Selby (2009), “By observing nature throughout changing seasons, early humans used inductive reasoning to form general ideas about patterns in their environment” (p. 593). Selby (2009) also mentions that “The stories we tell help students integrate their mathematical experience with their understanding of human condition” (p. 594).

The mathematical experiences of preschool children are influenced by the people around them. Most of the children participants in this study live with various members of extended families with ages ranging from 0-60. Children begin their mathematics learning from the activities that they are either engaged in or from their observations on activities that other family members are engaged in. As mentioned by Sheldon and Lepstein (2005) “subject-specific practices in school, family, and community partnerships may help educators improve students’ mathematics skills and achievement” (p. 196). Peressini (1998) suggests that efforts to change mathematics education have positioned parents on the sidelines, leaving educators and other professionals to decide how mathematics learning should take place. Peressini (1998) also mentions that parents are sometimes viewed as obstacles to children’s education. It is well accepted that children’s home environments affect their attitudes toward mathematics learning (Balli, 1998; Parsons,

Adler, & Kaczala, 1982). The environment includes people, places, and things with whom the child-participant interacts. The role that parents, guardians, and families play in student success in mathematics is as powerful as that of teachers! Parents' personal experiences, attitudes, understandings (and misunderstandings!) are often transferred to students. As children's chief role models, parents can do so much to assist and support their child's learning of mathematics. (Sonnenschein et al., 2012).

We are all aware that learning begins at home where a child is born and raised. Early mathematics literacy like other social and cognitive development begins at home and is shaped by the environment including the children and older people surrounding the child. This study will discuss how pre-school Kosraean children (ages 3-4) are engaged in mathematical activities at home, and what the influences from parents and other people are on their mathematics learning. Data were collected from a group of preschool children and their parents in order to describe early mathematics activities that are evident and explain how children at this development stage are engaged in activities involving numerical, spatial and measurement concepts at home. It is believed that parents play a major role in the mathematical development of pre-school children; therefore, this study seeks to describe parents' interactions with child participants, which may influence the mathematics learning development of their child.

Culture plays a central role in in both language and mathematics learning; therefore, the cognitive and physical development of a child is shaped by the people and is a reflection of the child's culture. In addition to the beliefs, values, and ways of life of a group of people, culture also includes the community's funds of knowledge-different types of knowledge and skills passed down to future generations that are vital for well-being in that community (Ladson-Billings, 1995; Moll et al., 1992; Nieto, 1996).

Central components of these types of knowledge and skills are the language and literacy skills that are needed to learn and apply these funds of knowledge to mathematics learning. In school, culture guides how students communicate and apply information and meaning, and learning about culture plays an equally important role in helping students understand who they are and their place in the world. This type of learning reflects the kind of cultural influences in preschool mathematics learning. Classroom instruction that is closely connected to students' home cultures and engages community resources in the learning process has positive impacts on learning

(Ladson-Billings, 1995; Moll et al., 1992; Nieto, 1996). Likewise, the teaching and learning at home are closely connected to the culture and community resources in the learning process. Mathematics activities and games for preschool children (ages 3 and 4) are viewed as informal and most often unrecognized as mathematics learning.

### Pre-counting Activities

Children at the ages of 3 and 4 are engaged in pre-counting activities through their interactions with peers and other children in the neighborhood (Wang, et al., 1971). While playing games and assisting with parents activities at the homes, they unknowingly pick up some basic mathematics languages and some mathematics pre-counting skills. Children also learn some mathematics from the household chores they are trained to do, which are often routine morning and evening chores such as picking up rubbish and fetching drinking water. Some of these household chores are the same chores that their parents said they did even when they were young. Although culture continues to change, some activities at home remain unchanged. Before children begin to count and learn about numeration, they start developing some mathematics language through sorting, matching, ordering, and measuring. Although children may be able to recognize number symbols, they could not relate symbols to values of numeration. Although children at the ages of 3 and 4 are able to rote count to five, they still could not connect the values of numbers to appropriate numbers in the number sequence. Pre-counting activities help children to develop the concept of number and the concept of counting. Although preschool children might be able to rote-count to five or a little higher, they do not understand that the number words they say are numbers that must be counted in correct sequence. The concept of numbers and the concept of counting begin to build after being engaged in pre-counting activities that involve sorting, matching, ordering, and measuring.

### Sorting

Sorting and classifying are basic pre-counting concepts that are developed through children manipulating and organizing objects based on similarities and differences. Children ages 3 and 4 or even younger deal with sizes, colors, shapes, and textures of objects they play with. They tend to think of bigger toys as stronger and better. Young children also recognize solid colors such as

red, green, blue, black, yellow, and white as the only colors. Kosraean children do not recognize color blends since there is no specific name for light colors. Pink roses are also identified as red (*sruhsrah*). Orange colors are recognized as either red or yellow. Children at pre-school age also like to feel objects and describe their textures as soft or hard. Sorting and classifying games help kindergarteners improve vocabulary, mathematics skills and logical thinking. According to Shoop (n.d.), “These activities help small children identify alike, different and opposite items as well as give them experiences with different sizes, colors, textures, and visual stimuli”.

### Matching

Matching in mathematics includes comparing the shapes, colors, textures, and sizes of manipulative objects the children use or play with. The colors of objects they play with, and patterns the children are putting together based on likenesses or similarities. Matching activities help children develop the concept of one to one correspondence, which leads directly to counting. These basic matching activities lead to the understanding of matching sets or groups of objects. Some children are not able to count yet, but they recognize that two objects are more than one, and when one is taken away, the child knows and looks for the missing object. Providing children with a strong background in basic mathematics concepts through activities and games will help prepare them to perform more complex mathematics operations later (Shoop, n.d.).

### Ordering

Learning to put things in order is important in preschool mathematics development. Ordering activities for children at the ages of 4 and 5 include putting objects in order of size, arranging the objects in order of length or height. They should be provided with engaging ordering hands-on activities that catch their attention.

### Measuring

Measuring begins without using number. Preschool children begin measuring objects by comparing properties of two objects. Preschool children when asked to measure their heights,

they go to a child next by to compare their heights. They measure things by comparing their heights, sizes, and lengths. When asked how tall a coconut tree is, they say, it is taller than something, very tall or too tall (*loeslac*). This extends to ordering three or more objects by pair to pair comparison. They have little knowledge about units of length; although, they are able to compare and distinguish tall and short objects or long and short objects. Preschool children's first use of number in measuring comes when they use one object to compare with another object. They are able to realize that it takes a certain number of a shorter object to make up to one of the longer object being compared. When provided some tangerines to use to measure with, they are able to line the tangerines up to make the same length of the object being compared with. Although, they know that more tangerines are used to make the same length of a paper or a table, they still do not understand the concept of unit as used in measurement. As Sophian (2002) discusses, little information is available about what children under 5 years of age might be able to understand about the relation between unit size and number. Young children disregard unit size when measuring or comparing objects. They think that the bigger the size of an object is or the longer the length of an object is, the bigger the quantity of parts to fit in without considering the differences in unit size.

Children's gender sometimes determines what kind of measurement activities children choose. Girls usually compare the lengths of her hair with other girls at the homes or in the community. They are engaged in measurement activities from the objects and toys they play with, which are different from the objects and toys that boys play with. Boys at these ages (3 and 4) do not measure or compare lengths of hair but may compare the sizes of objects including sizes of boys' toys they play with. Often times when boys and girls are placed together, they compete with each other. Children at these ages understand the idea of "mine", "his", and "hers. They play make-believe with dolls, animals, and people (Guam Department of Education, 2013). When asked to measure something, they want to have the taller or longer object.

### Basic counting

Basic counting begins at home when children begin putting things in order and realizing that some groups have more objects than others while playing games and performing household chores. Children might begin putting groups of objects in order most to least or from least to most. Preschool children learn to rote count after listening to other children or other people

counting without really understanding the values of numbers. Children begin the process of constructing mathematical knowledge and begin to understand the concept of one to one correspondence in counting well before they enter school. Although the process of constructing mathematical knowledge begins well before children begin school, children are thought to have limited mathematical understanding. However, as mentioned by Pepper and Hunting (1998), research by Rea and Reys (1970), Hendrickson (1979), Hughes (1986), Bergeron and Herscovics (1990), Young-Loveridge (1987), and Kamii (1985) has shown that young children have an impressive range of numerical skills at the onset of schooling. The Curriculum and Evaluation Standards for School Mathematics (National Council of Teachers of Mathematics 1989) stated that “children enter kindergarten with considerable mathematical experience, a partial understanding of many concepts, and some important skills, including counting” (p. 16).

Not only do young children come to school with a wealth of informal mathematical concepts and variable skills and abilities, there is evidence that their understanding of conceptual aspects of mathematics “may not be manifest in their efforts to communicate using conventional symbolism” (Pepper & Hunting, 1998, p. 164).

Counting one to one correspondence and numeration in most psychological research on children’s mathematical development focusing on the emergence of conservation and related abilities associated with the stage of concrete operations (Lovell 1996, Piaget 1965, Sigel & Hooper 1968). Counting and numeration are learned independently. Counting and numeration skills for quantities up to five would normally be learned before either class of skills was learned for quantities up to ten. In mathematical theory, one to one correspondence occupies a central position as the basis of concept of number. Counting, not unexpectedly, was the most prevalent and most common mathematical event.

The research describes pre-counting activities learned by preschool children, identifies unit of measurement used by young children to measure objects and why these units are used. Several counting systems are used today: counting systems for round objects, counting systems for long objects, and counting systems for sets or groups. Today these counting systems are adapted to be used like the western counting systems. Children are taught to count everything with one common counting system, or to count by twos. Did our ancestors know counting by twos?

Children are taught the concept of group as a set of numbers. There has been none or very little research done on the history of Kosrae Island with a direct focus on young children's learning of mathematics.

## STUDY DESIGN AND METHODOLOGY

This study sought to collect information related to the impact of parents and the home on the development of mathematical concepts among young children of pre-school ages. Preschool age is defined in this study as children ages 3 and 4, who have never been in school. Participants were 8 pre-school children and their parents selected from a group of 12 families. After receiving a listing of all children ages 3 and 4 from the Kosrae Statistics Office, I called the parents inviting them to a meeting at the Utwe Elementary School complex. Since some of these parents were not able to be reached by phone, I had to go to their homes and personally invited them to the meeting. 14 parents showed up at the meeting, and I explained to them about the research and provided them consent notes to take home and return them in the next meeting. 12 parents showed up in the next meeting bringing with them their consent notes. More details of the research were explained and discussed prior to the collection of the consent notes. After reviewing the consent notes, I decided to work with 8 families and children, with the selection based on the following criteria:

- 2 Children with sibling(s) attending an Elementary School alone
- 2 Children with sibling(s) attending a secondary school alone
- 2 Children with sibling(s) attending elementary school and other siblings attending secondary school
- 2 Children without siblings attending school; neither attending elementary school nor attending secondary school.

The other four families did not make it through the selection because they were reluctant to participate in the research.

### Questions guiding data collection

The following questions were used as guides to collect sufficient data to describe the mathematics learning at the homes.

1. What are motivating materials children can manipulate?
2. What are the mathematical languages used by pre-school children, parents and sibling?
3. What supportive and encouraging languages used?

4. What type of mathematical language is promoted?
5. What activities involve measurement? For instance, what things are compared as bigger than, taller than, and/or more than?
6. Is there any parental guidance to help with misconceptions?
7. Do parents recognize mathematical activities as mathematics?
8. What pre-counting activities are preschool children engaged in?
  - a. Sorting and classification
  - b. Matching
  - c. Ordering
  - d. Comparing (beginnings of measurement)
9. Are written numerals recognized by the child, and if so, do they make any sense to the preschool children in the study?
10. What activities involve development of number concepts?
11. Do children at this age understand that numbers may record the size of a group, or they may give the place of an item in the collection?
12. What are the typical toys and household items commonly used?

Since the participants live in the same village with the researcher and are located in walking distances, most consent notes were hand-delivered. Telephones were utilized when necessary.

Family profiles for all eight families were developed from data generated from three focus group meetings attended by the parents of the 8 research participants, observations of the children at their homes, and parents' diaries recording events parents perceive as connected with mathematics. These diaries were kept at the homes and shared with the researcher during the home visits. There were three interviews with parents throughout the research period to document data from parents' observations and diaries. Parents were asked to do an oral history of their mathematics experiences recalling mathematics they have been engaged in as far back as possible.

Detailed case studies were generated for five of the eight participant case studies. This decision was taken to make the task manageable. The family profiles for those families for whom a case was not generated are included in an appendix.

The research paradigm for this study is constructivist in nature. The ontology for constructivism rests on the notion that realities are “apprehendable in the form of abstract mental constructions that are experientially based, local, and specific” (Guba & Lincoln, 1994, p. 110). As described by Hatch (2002),

individual constructions of reality compose the knowledge of interest to constructivist researchers; however, it is through mutual engagement that researchers and respondents construct the subjective reality that is under investigation (p. 15).

Hatch (2002) also mentions that constructivists think of their participants as constructors of the knowledge generated by their studies, and I would like to think of my participants likewise. Data were gathered from participants’ observations and interviews. The study is a descriptive research depicting existing mathematics learning at home. The learning approaches at home were studied as they were juxtaposed with the mathematics learning approaches in first grade classrooms.

There were extended periods of time spent interviewing parents participating in the research and observing children at their homes in an effort to describe mathematical activities the eight children, ages 3 and 4 are engaged in at home. This is a qualitative research study focusing on the role of parents in the mathematical learning and development of a child prior to his first formal education in school. Children’s mathematics learning is believed to have some influences from other family members living with the child or other children in the neighborhood. This research has been designed to focus on children’s mathematical activities at their homes.

Although this research is geared toward mathematics learning development, I am aware that some new knowledge may emerge and may bring unexpected perspectives on early mathematics learning development. Therefore, my research focus must allow for some flexibility in regards to cultural learning.

#### Categories of participants

I wanted to have a sample of eight children who have yet to be in school, and come from families with a child participant’s siblings that fitting into one of the categories below.

- a. neither sibling attending elementary school nor attending secondary school,

- b. one or more siblings attending elementary and one or more attending secondary school,
- c. one or more attending elementary but none attending secondary,
- d. one or more attending secondary but none attending elementary school.

This research was conducted in the village of Utwe in Kosrae. Utwe is a small village with a population of 982 people (Kosrae Census,2010). The children who were involved in this study live in homes situated along the coast. The household sizes range from five-member nuclear families to more than ten -member extended families.

Some data collected included but were not limited to, age, gender, family background, duration of time each participant spent with the mother, and mathematics activities learned from the culture while being with the mother, duration of time spent with the father and mathematics learned from the culture while being with the father, duration of time with both parents and mathematics learned from the culture while being with both parents, duration of time away from parents and mathematics learned while being away from parents, duration of time with peers and mathematics learned while being with peers, and etc.

#### Participant Observation Context

Observations help to document activities that are done at the homes of pre-school children. These observations took into considerations that pre-school children may have influences to their mathematics learning from several people including young children at the homes and around the neighborhood. As described by Hatch (2002), the goal of observation is to understand the culture, setting, or social phenomenon being studied from the perspectives of the participants. Hatch claims that:

Observers attempt to see the world through the eyes of those they are studying. They observe carefully in an effort to acquire members' knowledge and consequently understand from the participants' point of view what motivated the participants to do what the researcher has observed them doing and what these acts meant at the time (Schwartz & Jacobs, 1979, p. 8)

The participants are the ultimate gatekeepers, and they determine whether and to what extent the researcher will have access to the information desired (Hatch, 2002 pp. 51). This study is much narrower in scope than an ethnography because the researcher has entered the field with a specific interest, which was to discover how children learn mathematics in the culture, especially in the homes. Being conducted on children living on the same village was advantageous to this research. It took four days to observe all the 8 student participants in the first week for the general observations. The general observations were purposely to gather general glimpses of the child participants' environment including the people, places, and things they interact with. The second round of observations following the general observations was specifically to collect data regarding mathematical knowledge, concepts, and the types of mathematical learning at their homes. Raw field notes were taken and then transcribed in order that only the mathematics related activities are sorted from the number of activities recorded. The field notes also include the child's interaction with other children in the neighborhood and the parents' engagement in the child's activities.

Hatch (2002) describes raw field notes as descriptions of contexts, actions, and conversations written in as much detail as possible given the constraints of watching and writing in a rapidly changing social environment. There was considerable time spent observing in the field to gather data with the following questions of interest.

#### Research Questions

1. When does the development of mathematics knowledge begin at home? What kind of mathematics knowledge and skills are gained and at what age?
2. What impacts do the educational levels of parents have in the mathematics learning of their children?
3. What impacts do siblings at the elementary level have in the mathematics development of the participant?
4. What impacts do siblings at secondary level have on the mathematics development of the participant?
5. What are the teaching and learning approaches?
  - a. Direct Instruction

- b. Indirect or informal learning
  - i. learning from watching
  - ii. games
  - iii. story-telling
- c. Parent-assisted learning
  - i. Doing household chores
  - ii. Farming and fishing activities

### Interview Context

The nature of the interview was informant interviewing in that there were a set of open-ended questions chosen to collect information on specific topic of interest. A questionnaire were developed for the purpose of collecting data on child rearing practices with a heavy focus on mathematics learning. Each child's parents were interviewed three times; one at the beginning of the research, another one in the middle, and one at the end.

The data collected from the interviews generated descriptions of how the children in the study have been raised. It was anticipated that parents would talk about child rearing in the past, before hospitals and public health services were established in comparison to the ways children of today are being raised. Most people do not mind being interviewed, but they feel more open and relaxed when interviewed, especially at their homes. I chatted with two women at one of these women's house and realized that the older of these two had lesser time talking. I then realized that she was more cautious with the information she was sharing, and she was uncomfortable sharing information while being with others. After the interview, she invited me to schedule another time for her alone to share some precious knowledge regarding child rearing practices. As resulted from this experience, interviews were done at places that were of least restrictive, which in this study are usually the homes with only the parents and in some cases with the children being present.

Demographic information collected from the interview included age of interviewee and household sizes. The participant parents were also asked to share information regarding highest

school grade completed and if applicable, to share information regarding Institutions of Higher Education attended. Table 2.1 shows the form used to collect personal data from the parents. Names used in the following narrative are typical Kosraean names used in place of the actual names of research participants.

Table 2.1  
Participant’s Parent Information Questionnaire

Name of Child (Participant) \_\_\_\_\_

Mother’s Name	Age	Highest Grade Completed	Institution of Higher Ed.	Occupation/Work History
Father’s Name	Age	Highest Grade Completed	Institution of Higher Ed.	Occupation/Work History

No. of children not in school \_\_\_\_\_  
 No. of children attending elementary school \_\_\_\_\_  
 No. of children attending secondary school \_\_\_\_\_  
 No. of children attending higher institutions \_\_\_\_\_

## Oral mathematics history and context

The role that parents, guardians, and families play in student success in mathematics is as powerful as that of teachers! Parents' personal experiences, attitudes, understandings (and misunderstandings!) are often transferred to students. As children's chief role models, parents can do so much to assist and support their child's learning of mathematics. Parents were asked to share personal oral mathematics history so that their past early mathematics experiences could be weighed against their children's mathematics learning experiences. Parents interviewed were asked to share their personal oral history of mathematical experiences, looking as far back as they could recall.

## Parent recollection of mathematics experiences

The information collected from the oral history interviews was necessary since it was used to gauge how much the parent mathematics experiences could potentially influence the mathematics learning of their children. Interviews were conducted in Kosraean and were audiotaped. Audiotaped recordings were then transcribed. The parents interviewed for the oral history are the parent or guardian of the child that spends most time with the child. Each parent was asked to share his or her mathematics experience looking as far back as could be recalled. To guide the sharing and discussion, each interviewee was asked to share experiences during preschool years, kindergarten, elementary, secondary, and postsecondary levels.

## Data Analysis

Qualitative analyses were conducted on data collected from parents' interviews, children's participations, and parents' oral history. Interview responses were categorized according to common answers about mathematics learning. Field notes from the observations were analyzed to identify significant events relating to preschool mathematics learning in the homes and the influences to the children's mathematics learning, as they will be used to inform other parents and kindergarten teachers of the importance of facilitating preschool children's early mathematics learning through activities in the homes.

## OUTCOMES OF THE STUDY

### Parent Interviews

Prior to entering school and receiving formal education in kindergarten programs, the parents interviewed talked about games and household chores. Parents also shared types of stories that were told to them orally. They think that they began to pick up some mathematics language and pre-counting and counting skills while playing games and doing household chores. Some games played at home prior to the first year in school included:

- Hide and seek
- Playing with rocks and stones- A game involving counting the number of rocks and stones caught or garnered.
- *Oli* (hopping and skipping game)- A game involving hoping and skipping over set numbers of circles and semicircles.
- *Pucspucs* competition- A racing game involving speed in the collection of fruits from a shoreline tree
- Marble games- A game involving shooting of marbles
- *Kingking*- A game involving pairs of numbers making six.
- *Kotaro*- A game involving speed of rolling objects on a race track made on a sloped sandy beach
- *Kahkah* – A game involving counting to ten and tagging opponents
- *Akuhtuhn tatngal*- A game involving shooting or knocking down of objects
- *Sahkfahreng*- A game involving two teams taking turns tagging.

Parents experiences in the games they used to play were often shared with their children.

Household chores are routine activities that the parent-participants did at home prior to entering school or any formal education. The activities mentioned are usually the ones done in the early morning or in the afternoon.

- Picking up rubbish and trash
- Fetching drinking water
- Collecting seashells

- Sweeping floors
- Washing dishes
- Gathering fish from father's catches
- Carrying fish containers
- Catching small fish

Stories shared by the parent participants are bed-time stories. As listed, popular stories for parent participants were bible stories, family lineage, and fighting and wars between commoners and nobles, and wars between island kingdoms.

- Bible stories of Abraham and his descendants
- Kinship and family lineage
- "Sitsit"- A story about a giant and a boy named Sitsit
- The Legend of Nipartak (War between 2 Island Kingdoms)
- Tamulel Nefalil- (War between commoners and nobles)
- The Legend of Loat Tafout-(Formation of a village)
- The Legend of the Giant Gecko (Srosrok)- A story about a huge gecko taking out and eating half of the people on each of five canoes coming in even numbers (2-10) across its cave.

After the informal mathematics experiences at home, the parent participants talked about mathematics experiences in Head Start or Kindergarten programs. These programs were formal education preparatory programs. These programs have changed names over the years. Originally it was called Head Start. Later on it was called Pre-school, and currently it is Early Childhood Education. These changes are based on proposed early education services for identified preschool ages. Recently, the Early Child Education services are provided for children at the age of five; however, children who are found to have physical disabilities or mental disabilities are provided early education services through the ECE program at early as age 3. These programs provide preparatory mathematics exercises, which included basic counting and adding activities. Most school supplies were commercial school materials, which replaced most local materials used in the classrooms. Mathematics activities mentioned as common and much preferable by

parent participants during their Head Start and Preschool years in school included but not limited to:

- Counting and Adding using base ten blocks
- Playing with toy money
- Dancing
- tallying to represent values of numbers
- hate math
- identifying shapes
- learned about diamonds and squares

Mathematics experiences at the primary levels

- Addition drills-  $1+1=2$ ,  $2+2=4$ ,  $4+4=8$ ,  $8+8=16$
- Multiplication -mastering the multiplication table
- Distinguishing limestone (*yot fasrfasr*) and basalt (*yot sroalsroal*).
- Mathematics involving circumference and radius.
- Beginning algebra
- Subtraction
- Loves multiplication and mastered the multiplication table
- Learned short cut to mathematics problem solving activities

Mathematics experiences at the secondary levels

- Mathematics formula for solving problems including Mathematics formula in science
- Hate algebra and geometry
- Received tutorial programs
- Struggled with Algebra and trigonometry
- Hate the mathematics in chemistry classes

## Post-secondary mathematics experiences

- Algebra and Trigonometry
- Hate precalculus
- Statistics
- Probability
- Accounting
- Business Administration
- Military service

The participant parents were asked to share ways they try to help their children to learn math. It has been realized that parents spend less time helping their children with mathematics learning. Throughout the research, parents started paying attention to the mathematics activities and languages that their children are engaged in.

## Family profiles and case studies

The family profiles describe the family members and each child participating in the research. This information comes from parents' diaries and the observer field notes. Names used in the tables are typical Kosraean names used in place of the actual names of research participants.

The eight families were paired, making four pairs based on the category or type of family they fall under. The two families under category one were those without siblings of the child research participant in school. The two families under category two were those with siblings of the child participant attending elementary school level. The two families under category three were those with siblings of the child participant attending secondary school level. The last two families were those with siblings of the child participant attending both elementary school and secondary school. Case studies were developed profiling five of the eight families, two were of children without siblings in school, while the other three had at least one sibling in either elementary or secondary school. The family profiles of the three families not used in the case studies appear in Appendix 2.

The purpose of the case studies was to shed light on how the child research participant's mathematics learning development has been influenced by siblings and other members of the

family. The environment where the child’s home is situated was also looked at for the same purpose.

Category 1: Child with no siblings in school

*Family profile: Kilafwakun Family–Tulpe*

Table 3.1

Child Participant Profile	Mother’s/Guardian’s Profile	Father’s Profile
Name: Tulpe Kilafwakun Lives with matrilineal family, including aunts, cousins, a brother and a sister.	Name: SeShrue Age: 37 Highest Grade Completed:12 IHE Completed: COM-FSM Occupation/Work History: Teaching at the Kosrae Seventh Day Adventist School-Preschool Level	Name: Kilafwakun Age: 34 Highest Grade Completed: 12 IHE Completed:COM-FSM Occupation/Work History: Taught at Utwe Elementary School, Teaching at Kosrae High School- Junior Level

Tulpe is a 4-year old girl living with her nuclear family. Spending most of her time with her aunt and patrilineal grandparents since both parent are working parents. Her mother teaches at the Seventh Day Adventist School as a Preschool (Kindergarten) teacher. Her father started working at Utwe Elementary School, and later moved to Kosrae High School and currently works there as a Junior Level Science and Social Studies teacher.

Things that Tulpe manipulates

- Candies, coins, stones, clothes, tangerines

Mathematical Language used at home by the child, parents, siblings and other members of the family

- *Sie-one*

- *Soko*-one for long and moving objects
- *Puhkantwen*- numerous or alot
- *Yohk*-big
- *Srihk*-small

Mathematical language promoted at home

- Common counting words: *sie, luo, tolu, ahkosr, limekohsr* (one, two, three, four, five)

Measurement Activities

- Family members: old-young, big-small
- Toys: small-big, few-many
- Fruits: small-big; few-many

Do parents help with misconceptions? (what kind of misconceptions and what kind of help provided)

- Parents help correct child when she uses inappropriate words for counting, for example dogs are counted with *soko, lukwac...*, but not *sie, luo*.
- When the child miscounts, the parents corrects her and ask her to count again until she get it correct

Do parents realize that activities are mathematics activities?

- Parents supports and encourages their child to play with cousins and friends imitating roles of customers and store keepers. Parents believe that the child begins learning mathematics from such activity

What are some pre-counting activities?

Sorting

- Sorts objects based on colors and sizes

Matching

- Matches clothes with same color clothes

Ordering

- Not yet able to arrange objects in order based on sizes or quantities

Can the child write numbers?

- Although she is able to rote count to five, she cannot write any number.

Does the child understand the concept of numbers (numeration and values of numbers)

- She differentiates quantities of objects but cannot relate them with written numerals.

What are her typical toys?

- Dolls and hair pins

*Case study: Kilafwakun family–Tulpe*

The Kilafwakun Family is a five-member family consisting of the parents (mother and father) and three children. The eldest child is a 5-year old boy. The 4-year old female child participant, who we will call Tulpe, is a year younger, and the youngest is a 2-year old baby girl. Tulpe's father is 34 years old and comes from a family of six with him being the second eldest in the family. He has two brothers and three sisters. He went to school at the Community College of Micronesia-FSM and received an Associate of Arts degree in Education. He began his teaching career at Utwe Elementary School, teaching science and social studies. When his one-year probationary service term ended at the elementary level, he moved to Kosrae High School. He teaches Biology to a Junior class and environmental science to a freshmen class.

Tulpe's mother is 37 years old and comes from a family of twelve with her being the 12<sup>th</sup> in the family. She has a twin sister and seven other older sisters. She also has four older brothers. She began her teaching career at a private school after returning from her missionary training in the Philippines. Tulpe's mother works at the Kosrae Seventh Day Adventist (SDA) School, teaching a group of kindergarteners. SDA is an English speaking school, and it is the only private school on Kosrae. Most students attending SDA are Kosraeans, A few students come from families of minority groups, especially expatriates. Aside from her teaching job, she also takes courses after work at the Community College of Micronesia-FSM towards her Associate of Science Degree in Nursing. A majority of the teaching staff are contract teachers recruited from outside of Kosrae. SDA is the only parochial school and English is both the language of instruction and the medium of expression.

English is the language of instruction and often the language of communication at both the SDA School and Kosrae High School; however, when Tulpe's parents return home, the language used at home is the indigenous local language, which is Kosraean. Kosraean is the language totally spoken at the homes of both the mother's and the father's families. Although Kosraean is the

primary language used at home, Tulpe has had some exposure to the English language, which has been used at the SDA church. On Saturdays at church, teachers help with singing of English church hymnals and teaching Sabbath School lessons for all ages. Tulpe is sometimes taught to recite English Bible verses for Sabbath School.

Tulpe spends most of her time with her aunt at home. Tulpe's aunt takes care of her and her brother and sister when their parents are gone for work. Sometimes, the children are dropped off at the home of the father's family to be taken care of by either the grandparents or the patrilineal aunts.

At Tulpe's home, there is a cook house and a concrete dwelling house. The dwelling house is also used by the big family as a gathering or meeting place. A retail store is located about fifty meters away from the child's home. The retail store is more like a family store, where the family gets their groceries from. Tulpe would sometimes buy her sweets and snacks from this store. At other times, she would just visit or play around the store. The distance from the house to the shore is a five-minute walk. A fringing reef which is one hundred feet away from the shoreline provides a fishing place and swimming area during high tide. When the tide is low, there are tide pools where little fishes, and other sources of seafood could be found. The shore provides a play area where the children could collect sea shells, sand, gravel, and rocks. Fruits from the trees growing along the shore are sometimes used for games. Going a few yards inland, several fruit trees like breadfruits, coconuts, lemons, papaya, bananas, and tangerines surround the house. There is a graveyard about 50 feet from the dwelling house. The nearest house neighboring Tulpe's home is about 200 feet away, and this makes Tulpe's home a spaced neighborhood. It would take several minutes by car to get to the village.

While at home, Tulpe spends a majority of her time playing in-doors. When her parents return from work, she would play outside and around the house, at the store, or with her older brother and other children visiting her home.

I spent two hours each visit watching the child while she interacted with her siblings and other children visiting her home. The first visit was purposely to observe general activities the child was engaged in, and the second observation was to collect data on the mathematical knowledge and skills that this preschool child has. I was also looking for possible influences on the

preschool child's learning. Since the child does not have siblings attending school, I focused on observing her interactions with her older brother and her younger sister and other people in the family.

The general observation on Tulpe was done during one morning when the preschool child had her seven-year-old cousin who is in 3rd grade at her house. The two girls had a series of activities for the duration of one hour as listed below.

1. playing with a balloon,
2. running around in the house taking turns tagging.
3. looking at pictures on a digital camera.
4. watching TV. They chose to watch "Cinderella."
5. playing volleyball with their balloon.
6. watching TV. This time they switched movie to the "Three Stooges."

They kept switching from watching TV to playing volleyball with their balloon most of the time, and I was there observing for the language they were using and the motor skills applied in the volleyball activities. My observations were focused more on directional words and counting and pre-counting words. Eye-hand coordination was also observed because they were only counting the number of times they hit the ball. They did not count all attempts to hit the ball that missed.

- They understood directions of up and down. They took turns hitting the balloon and trying to keep the balloons in the air. They were using words like "lucng" meaning up and "ten" meaning down.
- At one time they were counting the number of hits on the balloon altogether as they were taking turns hitting. They were counting by tens, but started with 30. Tulpe started counting with 30 and then 40. She skipped 50 and counted 60. It seemed like the child has learned to skip count by tens, but does not understand values of numbers. There was no interaction from Tulpe's mother or her cousin's mother. They were left alone to play by themselves.

The second observation was done on an evening while Tulpe was home with her mother, aunt, and her older brother and younger sister. I brought some candies for her to use to answer questions relating to grouping and sorting by colors, shapes, and sizes. The child was asked first

to sort candies based on color, and then shapes, and then sizes. The child was then asked to seriate items based on sizes and lengths.

- The child was able to sort candies by colors (*sruhsrah*-red, *folfol*-blue, and *rangrang*-yellow)
- The child was able to sort candies by shapes. She was able to differentiate round candies from long candies. She understands *raun*-round, and *loes*-short.
- The child was able to seriate five items from smallest (*srihk emet*) to biggest (*yohk emet*) and from shortest (*fototo emet*) to longest (*loes emet*).

The common mathematical language spoken at home involves counting words (numbers) and comparison words. When comparing items, Tulpe often compares the items she possesses with others. When given candies to count, Tulpe touched one candy at a time with her finger and counted them. She was able to count the candies from one to seven using correct number words using the common counting system (*sie*-one, *luo*-two, *tolu*-three, *ahkosr*-four, *limekohsr*-five, *ohnkohsr*-six, *itkohsr*-seven). From seven, she skips eight and says *yuc*, which is nine and then says *singuul*, which is ten. This is an indication that she has memorized counting from one to seven, but has yet to master 8, 9, and 10 in the number sequence. She is able to distinguish quantities of objects and is able to tell which group of objects has more members (*puhs*) or more numerous (*puhkantwen*), and which group of objects has fewer members (*suhpuhs*). She could also distinguish between big and small and used words like (*yohk*-big and *srihk*-small and *yohk emet*-biggest and *srihk emet*-smallest).

Measurement ability is limited to just comparing items in relation to size and length. When asked how tall Tulpe is, she compared her own height with those of the other children with her. Instead of doing any measurement and telling her height with a unit of measurement, she said that her older brother is taller and her younger sister is shorter. She also compared her height with her mother's height and her father's height. She knew that her mother is taller than her, but she is shorter than her father.

Tulpe's errors are often corrected by her parents, and most of the time it is her mother that does the correction and teaching of new words. When Tulpe says a counting word that is not the appropriate word for counting a particular object, the parents correct her and tell her the right

counting word. Tulpe was asked to tell how many dogs there were, sitting by the door, and she said *kosro se*, which is the incorrect word for one dog. Her mother corrected her and told her that most animals are counted differently, and one dog should be counted with *soko* but not *sie*, *Soko* and *sie* both mean one, but they are used differently, depending on the type of object being counted. Tulpe was asked to count several objects (candies, shells, dogs), and every time she counted, she miscounted after seven and her mother asked her to count again starting from one. Counting is taught by Tulpe's mother in this way. By the age of four, a child is expected to be able to count from one to ten correctly. Although Tulpe is able to rote count up to seven, she is unable to write number symbols. She seems to understand that bigger numbers mean more and smaller numbers mean less in terms of quantity.

Tulpe's parents are generally aware that their child learns from the activities she is engaged in at home and around the neighborhood, however, they have limited knowledge of the mathematics involved in some of the activities that their child is engaged in. They understand that Tulpe begins her mathematics learning from them especially and from the people at home and in the community. Because of this, Tulpe learns her foundational knowledge and skills informally and indirectly through the games she plays and through her interactions with her siblings, parents, and children in the neighborhood.

After the discussions and conversations regarding preschool mathematics, Tulpe's father, who is a secondary Social Studies teacher, said that he started paying more attention to the games that Tulpe is playing, and became more interested in helping Tulpe learning mathematics from the activities she was engaged in. He tried teaching Tulpe to count using concrete, tangible objects such as pebbles and fruits that are available at home. Being classroom teachers and being able to identify the type of mathematics learning that develops from Tulpe's activities make the difference in her mathematics learning development.

*Family Profile: Aliksru family–Aliksru*

Table 3.2

Child Participant Profile	Mother <sup>2</sup> /Guardian’s Profile	Fatther’s Profile
Name: Aliksru(?)	Name: SiShra Age: 24 Highest Grade Completed:12 IHE Completed: COM-FSM Occupation/Work History: N/A	Name: Aliksru Age:58 Highest Grade Completed: 12 IHE Completed:COM-FSM Occupation/Work History: Clerk of Court

Aliksru(?) is a 4 year old boy living with an extended family. He is cared for most of the time by his aunt who is a single 24 year-old girl. He is an adopted child by a single mother. He is supported partly by his 58 year old grandfather.

Things that the child manipulates

- Plays with ipad games and rides his bicycle

Mathematical Language used at home by the child, parents, siblings and other members of the family

- Counting systems
  - *Soko* (ex.one pig) counting system for long objects including moving objects. He can only count 1 object with this counting system. When he counts objects more than one, then he switches to the common counting system.
  - *Sie* (ex. one house) common counting system
  - *Loeslaclac*-too long to mean longest
  - *Fototolaclac*-too short to mean shortest

Mathematical language promoted at home

- Common counting words: *sie, luo, tolu*,: The child can only count up to three correctly. When counting higher than three, he skips numbers.

Measurement Activities

- He can tell whether the amount of food served for him is bigger or smaller,
- He is able to tell that he is taller or shorter than others in the family

Do parents help with misconceptions? (what kind of misconceptions and what kind of help provided)?

- Parents help child to learn to count to five. When he misses a number, the parents correct him.
- When the child miscounts, the parents correct her and ask her to count again

Do parents realize that activities are mathematics activities?

- At first parents did not see their child's activities as having any connections to mathematics learning. After being involved in the research, they begin to pay attention to the child's activities and provide assistance for the child's mathematics development.

What are some pre-counting activities?

Sorting

- Sorts objects based on colors and sizes

Matching

- Matches small toys with groups of small toys and matches big toys likewise
- Matching three colors (red, green, and blue)

Ordering

- Puts objects in order from smallest to biggest
- Puts object in order from tallest to shortest

Can the child write numbers?

- Although he is able to rote count to three, he cannot write any number. His guardian tried to help him to write numbers, but he still does not understand values of numbers or symbols representing numbers

Does the child understand the concept of numbers (numeration and values of numbers)

- He differentiates quantities of objects but cannot relate them with written numerals.

What are the child's typical toys?

- Toy airplane, toy gun, baseball glove, bears, musical keyboard, and toy tools.

*Case study: Alikrsru family–Alikrsru*

The Alikrsru Family consists of a 4-year old adopted boy, who we will call Alikrsru, and his legal guardian. Alikrsru was adopted by his legal guardian at birth; however, his birth mother lived with him in his guardian's home until he was two. The legal guardian is a 35 year old working mother, who serves as a special assistant to the Kosrae State Governor. She comes from a family of five children; herself, two brothers and two sisters. She is the eldest child. While the legal guardian is at work, Alikrsru is under the care of his guardian's 24-year old sister. Alikrsru spends most of his time at home with his caregiver and two girls who are a year younger than him. These two girls are his cousins.

The legal guardian works during the day on her regular job and is also involved in other activities, such as serving on the Kosrae Education Advisory Board, participating in Education related functions, and participating in other community activities. The only available times for her to be with his son would be early in the morning before she leaves for work and a little time after work; however, she has all days Saturdays and Sundays.

I had the opportunity to do a general observation with Alikrsru at home one morning while he was with his caregiver and his two cousins. I was with him for two hours watching him interacting with both his two cousins and his caregiver. I was watching him and interviewing the caregiver at the same time. While the caregiver was telling her personal oral history, Alikrsru walked around us switching from playing with his toys on the ground and hitting his two cousins. When he hits his cousins, the caregiver would scold him to try to stop him. He seemed to be very active and just hitting the two children to get our attention. He kept walking around the house and would stop to play with his tricycle and his other toys by himself. During the period that Alikrsru was playing with his toys, I would get back to my interview with the caregiver. She told me that the child loves riding his tricycle outside and playing electronic games on the iPad. She told me that she has never thought the games she used to play when she was little had some impacts on her mathematics learning development. She had just realized that there could be mathematics involved in some activities that children are engaged in at their homes when I started asking her questions relating to mathematics learning at home; however,

she believes that Aliksru is able to learn some mathematics concepts if facilitated appropriately from the activities he was engaged in.

Aliksru's home is located on a hill, and at the foot of the hill runs the main road. This section of the main road is dirt and not paved. It would take about five minutes to walk from the house downhill to the main road, and walking from there to town would take about 2 hours. The closest neighboring house is about a hundred meters away; therefore, making Aliksru's home a bit isolated. There is a cook house ten feet from the rear of the dwelling house. The front yard is about ten meters wide and ten meters long. There is a big open parking space with a gravesite at one edge. Aliksru spends most of his time playing around the cook house where his tricycle and toys are. The three family dogs also stay at the cook house.

My observation with Aliksru was focused more on his pre-counting skills and current level of counting skills. Traditional counting in Kosraean has two main systems, although there are slight irregularities and inconsistencies in both systems. One counting system is used for counting long and moving objects; however, there are long and moving objects that are counted differently. Ten coconut trees, which fit in the description of long and tall objects, would be counted from one to ten with *soko, luka, tokwe, angko, lumko, onko, itko, oalko, yuko, signuul*. However, ten palm leaves, which also fit in the description of long objects, would properly be counted using the other counting system, and would be counted from one to ten with *sie, luo, tolu, akosr, limekosr, onkosr, itkosr, oalkosr, yu, singuul*. A child learns to say numbers or number words from older members of the family. As he grows older, his number vocabulary also increases. Wikipedia, the free encyclopedia states that the traditional way of counting consists of continually increasing a (mental or spoken) counter by a unit for every element of the set, in some order. ([en.wikipedia.org/wiki/Counting](http://en.wikipedia.org/wiki/Counting)).

There is another counting systems that is rarely used, and is considered as an old way of counting. This old way of counting uses *sra, lo, tol, ang, lum, on, it oal, yu, singuul* for counting objects from one to ten. The old way of counting is usually used by older people and is more like a universal counting system because it could be used to count any object regardless of its descriptive category. Counting sometimes involves numbers other than one; for example, when

counting money, counting out change, "counting by twos" (2, 4, 6, 8, 10, 12, ...), or "counting by fives" (5, 10, 15, 20, 25, ...) (en.wikipedia.org/wiki/Counting).

The common counting system is the counting system that most people use. Counting from one to ten in the Kosraean common counting system is *sie, luo, tolu, akosr, limekosr, onkosr, itkosr, oalkosr, yuc, singucul*. Counting onward from *singucul*, is adding the lower numbers in order with ten. Instead of giving a new word name for the number after ten, eleven is counted as ten and one. For example, eleven is counted as *singucul sie*, and twelve is counted as *singuul luo*. Young children are taught by their parents to count with the common counting system as they grow older. Preschool children are expected to be able to count with the counting system that is commonly used; however, when they count objects properly using the two main counting systems, they are praised and applauded.

The common counting system is the counting system taught at home and also in school. Even on a child's first birthday, the parents would teach their baby to raise one finger to indicate his age when asked how old he is. The common counting system is used when counting almost everything except some long and moving objects. Some other long and moving objects are counted using the common counting system. For example, members of the family are counted with the common counting system although they fit in the description for long and moving objects. The counting system for long and moving objects is maybe taught at home, but is not taught in school; therefore, it is seldom written. Young children often learn to use the counting system for long and moving objects after hearing others using it and imitating them.

Aliksru is able to say *soko*, which is the proper way of saying one when counting dogs. When asked to tell how many dogs are at the house, he said *kosro soko*, which is one dog. He could not count all three dogs, instead he counted the three dogs as *kosro soko*, which is one dog, the second dog as another dog, and the third dog as another dog again. Counting objects from one to ten in the common counting system uses *sie, luo, tolu, Akosr, limekosr, onkosr, itkosr, oalkosr, yu, singuul* when counting objects from one to ten. Most long and moving objects are counted with *soko, luka, tolkoe, angko, lumko, onko, itko, oalko, yuko, singuul*. Other long and moving objects are exceptionally counted in the common counting system. Young children are taught to recite numbers in order in the common counting system, and are often left to learn to count in the

other counting systems on their own. Young children might learn to say numbers in other counting systems by listening to other people counting with such counting systems. The child is only able to count one object with the counting system used for counting long and moving objects, this may be an indication that pre-school children, are not expected to learn the counting system for counting most long and moving objects.

When the child is asked to count two dogs or two pigs, he counted them as one dog (kosro soko) and another dog (kosro soko pac) or one pig (pik soko) and another pig (pik soko pac) instead of saying two dogs or two pigs.

Aliksru knows how to say one dog, but does not know how to count beyond one. He counted two dogs as one dog and another dog. However, when asked to count from one to ten, he counted one two, and three in the common counting system correctly, but skips four and counts five and then skips six and counts seven. The common counting system is the counting system often times used and taught to young preschool children. One to ten is counted in the common counting system as *sie, luo, tolu, akosr, limekosr, onkosr, itkosr, oalkosr, yu, singuul*. This child seemed to lack the knowledge and skills of counting numbers in sequence after three. He is still at the beginning stage of counting. Research suggests that it takes about a year after learning the skills of counting for a child to understand what they mean and why the procedures are performed. ([en.wikipedia.org/wiki/Counting](http://en.wikipedia.org/wiki/Counting)).

He has limited understanding of one to one relationship. When asked to show one, he raised one finger, and when asked to count the dogs, he pointed to one dog and said *kosro soko*, which means one dog. He knows that one finger represents one and one dog also represents one. Although, he knows that there are three dogs, when asked to count them all, he counted the second dog as another dog instead of counting on from one to two. He counted the third dog likewise as another dog.

Measuring is a pre-counting skill, and preschool children use a lot of irregular and non-standards units for measuring things. When asked to tell his height, Aliksru compared his own height with the heights of his two cousins. When his aunt, the caregiver, asked him how tall he is, he said, "*Nga loeslaclac*", meaning I am too tall. When asked to compare his height with that of his cousin, he said, "*El fototolaclac*," meaning she is too short instead of saying she is shorter. The

child has other pre-counting skills such as sorting objects based on colors , sizes, matching same quantities of small toys with other small toys, arranging lengths of trees from tallest to shortest.

The child does not understand numerals, and written number signs mean nothing to this child. He does not know how to write, and every counting and pre-counting activity is verbally or physically demonstrated.

The child's mother and his aunt that takes care of him when his mother is at work are not aware that the games and activities the child is engaged in have any connection to mathematics, and they pay very little attention to the math learning that comes from the games and activities. However, they understand that the child learns to count and tries to count, and when he makes a mistake in counting, they try to correct him, but they pay little attention to his mathematics learning. Some typical toys aside from the iPad that the child really loves playing with at home include, toy airplane, toy gun, baseball glove, bears, musical keyboard, and toy carpenter tools.

Aliksru's mother and his guardian, who is also his aunt, are now aware that mathematics learning starts at home through the games and activities that the child is engaged in. Prior to his formal mathematics education, which will be provided in school, they will pay more attention to the child's games and activities, and try to facilitate his mathematics learning through the games and activities.

There is no direct indication to what extent that the child's mother or aunt were successful in their mathematics studies in school. Nor do we know what impact their level of learning and their attitudes to mathematics may be having on the mathematics learning development of the child. The mother is a full time government employee who is also a member of the Kosrae Education Advisory Board. At other times, after work, she is occupied with activities for Women Association, Youth Christian Endeavor, Parents and Teachers Association, and other community activities. Her time with the child during weekdays is limited. The child's aunt acts as the child's guardian and caregiver and spends time with him and two other little girls almost everyday. She remembered doing home chores like fetching water for drinking in reused Clorox bottles when she was a preschooler. She was not aware that counting the water containers could help mathematics learning development. Her favorite mathematics activities at the primary elementary levels were activities involving the use of manipulates, such as building blocks, and

base ten blocks. By eighth grade, activities involving multiplication became fun and preferable. At Kosrae High School, she enjoyed activities involving geometry and algebra. She quit school after one year in college. When asked if she had ever tried teaching Aliksru any math, she replied, “only when he counts and makes mistakes in counting.”

Category 2: Siblings in elementary or secondary school

*Family profile: Nena Family–Alik*

Table 3.3

Child Participant Profile	Mother’s/Guardian’s Profile	Father’s Profile
Alik Nena Lives with matrilineal Grandparents most of the day. Spends more time in the evening with patrilineal family, including grandmother, uncles, aunts, cousins, and a sister.	Name: Sepe Age: 29 Highest Grade Completed: 12 IHE Completed: COM-FSM Teaching at Utwe Elementary School for 5years-3 <sup>rd</sup> Grade	Name: Nena Age: 36 Highest Grade Completed: 12 IHE Completed: N/A Occupation/Work History: Fisheries Specialist

Alik Nena is a 3 -ear old boy living with his extended family and spends some time with his matrilineal grandparents. His mother teaches at Utwe Elementary School and has been teaching 3<sup>rd</sup> grade mathematics for 5 years. His father works at the Office of Marine Resources as a Fisheries Specialist.

Things that the child manipulates

- Empty bottles and empty cans
- Crayons
- blocks

Mathematical Language used at home by the child, parents, siblings and other members of the family.

- *mwet luo toeni orekmakihn ma se* – two people sharing one thing
- *mahtuh ac srihk*-older and younger in age, shows number of fingers to represent age
- rote counting using *sie, luo, tolu*, the common counting system

Mathematical language promoted at home

- counting words: *sie, luo, tolu, ahkosr, limekosr* (rote counting up to five correctly)

#### Measurement Activities

- He can tell amount or volume of drinks (compares his drink with his cousins' drinks)
- Sharing candies-He likes to have equal share of candies with his cousins.

Do parents help with misconceptions? (what kind of misconceptions and what kind of help provided)

- His older sister tries to correct him when he says he is 3 years old and he is in 2<sup>nd</sup> grade.
- He realized that one pair of slippers was missing, he said he is looking for one slipper. He does not understand pairs.

Do parents realize that activities are mathematics activities?

- Sometimes when he counts number of objects, his mother realized that he is beginning to learn mathematics through games and playtimes with siblings and cousins.

What are some pre-counting activities?

#### Sorting

- Sorts roses and crayons based on colors
- Sorts leaves based on sizes

#### Matching

- Dirty objects belong to a group with things outside
- Small objects go in one group and bigger objects make another group
- Same color roses go in one group

#### Ordering

- He tried to organize shoes. His shoes first because they are smaller than his father's shoes. He did this after watching his older sister doing the same.
- Collected roses and leaves with kids in the neighborhood and compared his collection with others, and organized collections from least to most.

Can the child write numbers?

- Although he is able to rote count to five, he cannot write any number, but likes watching his sister writing numbers

Does the child understand the concept of numbers (numeration and values of numbers)?

- The child is able to tell that bigger numbers mean more or bigger sizes or quantities, but he is not able yet to relate values of numbers with one to one correspondence

What are the child's typical toys?

- Push bikes
- Toy car
- Toy bow and arrows
- Blocks
- Tennis ball
- Toy water gun
- Toy dump truck

*Case study: Nena family–Alik*

The Nena Family is a four-member family consisting of the parents (mother and father) and two children. The eldest child is a 5-year old girl who is an Early Childhood Education student at Utwe Elementary School. The other child is the 3-year old male child participant in this study who we will call Alik, Alik's father is 36 years old and comes from a family of seven with him being the eldest in the family. Residing with Alik's family are his mother who is a high school vocational education teacher, his mothers two brothers and one sister. Alik's father completed secondary school in Kosrae, and currently works at the office of Fisheries and Marine Resources as a Fisheries Specialist.

Alik's mother is 29 years old and comes from a family of seven with her being the 2<sup>nd</sup> eldest in the family. She has four brothers and two sisters. Her two sisters and one of her brothers got married and left the house. Living with Alik's mother's parents are her two younger brothers. Alik's matrilineal grandparents are subsistence farmers, and they take care of Alik during the day when Alik's parents go to work and his older sister goes to school. Alik's mother completed secondary school in Kosrae and spent two years at the Community College of Micronesia, where she received her Associate of Arts degree in Liberal Arts. She currently works at Utwe Elementary School as a classroom teacher teaching 3<sup>rd</sup> grade mathematics and science. She has worked at this school for 3 years. Aside from her teaching job, she also takes courses at the College of Micronesia-FSM, and she is doing these course works towards her College of

Micronesia 3<sup>rd</sup> Year Teacher Preparation Certification. After work, Alik's mother goes straight to the College for her classes, and after her classes, she gets home at around six O'clock in the evening. By the time she reaches home, the sun is already setting. There is less time for her to be with her two children during the day, but she could still speak with them in the evening before they go to bed.

The language spoken at home is the Kosraean vernacular, which is also the language spoken in school where Alik's older sister and his mother are at during the day. Alik has no other exposure to English except his cartoon movies.

Alik spends most of his time with his matrilineal grandparents who speak only Kosraean. At his grandparents' farm, there are vegetables, root crops, and other fruit trees. During my visit to the farm, there were cucumber and lettuce gardens, root crops such as taro and yam, and fruit trees like papaya, mango, breadfruit, and banana. The farm is on a hill and is far from town. Alik had no other children to play with or talk to at the farm. He played by himself in and around the house and sometimes helped with the farm.. The only people he could talk to at the farm are his grandparents. When school is over and Alik's parents get back from work, Alik goes back home to join them.

At Alik's home, there is a cook house and a 2-story concrete dwelling house. Alik's family lives upstairs in a single room. The rest of the family (uncles and aunts and grandmother) live downstairs.

At his home, Alik has his older sister and a male cousin to play with. During my first observation with Alik at his home, I spent two hours watching Alik while he played in and around the house. I was also looking for possible influences on Alik's mathematical learning. Since Alik has her older sister attending school, I was hoping to spend some time observing her as he interacts with Alik. Unfortunately, Alik did not spend much time with his sister, and he wanted to do things on his own. However, his mother told me that he likes copying what his older sister does, especially things that she does for school. She told me also that Alik learned to recite his sister's speech and learned to count from listening to his sister counting.

The general observation on Alik was done during one afternoon when Alik had her older sister at home, and his parents back at home from work. Other family members at the house were Alik's

patrilineal grandmother, one of his aunts, and one of his uncles. Alik was watching TV in their room upstairs when I got there. His parents called him to come downstairs where I was, and they started asking him some questions. They asked him to do his memorized speech, and he started saying his name, his father's name, his mother's name, his favorite food, and what he wants to be when he grows up. Afterward, he went to the front yard and stepped in a puddle of water and then came back and got into their family car. He stays in the car for a little longer than 15 minutes, and then he came out of the car crying because the Koo Aid powder he got on the blisters on his hand was painful. When asked how many packets of cool aid he tore in the car, he said, "*ma sie fanna*" (there is only one). He wanted to go back to the room and watch TV, but his mother told him to answer a few questions before he goes up to the room. His mother asked him how many pigs there are in the pig pen, and he said, "*ma se fanna*," meaning there is only one. His mother asked him again how many cats they have, and he said, "*ma se fanna*," again. When asked to count, he counted up to three (*sie, luo, tolu*-one, two, three). When asked to count again, he counted up to five (*sie, luo, tolu, akosr, limekosr*-one, two, three, four, five). He could only rote count up to five correctly.

The second observation was purposely to collect data from activities that Alik was engaged in, which might have some relation to his mathematical learning. When asked who is older between himself and her older sister, he said, "*el mahtuh ac nga srihk*"-she is older and I am younger. He was able to compare the ages of two individuals, himself and her sister, who is a year older. He was able to tell that his sister is older than him. When asked how old he was, he showed three fingers and said, "*tolu*"-three. Alik had empty bottles, empty cans, crayons and wooden blocks to play with at home. The mathematical language used at home is Kosraean. I was able to record some of the words and phrases that he used at home. When he saw two people sharing one cup for drinking water, he said, "*mwet luo toeni orekmakihn ma se*" (two people sharing one thing). He was able to tell that there were two people, and that they were sharing one cup.

The counting words taught at home are: *sie, luo, tolu, ahkosr, limekosr, onkosr, itkosr, oalkosr, yu, singuul* (one, two, three, four, five, six, seven, eight, nine, ten). Alik was only able to do rote counting up to five correctly. When given some candies to share with his sister, he liked the share to be equal. He could tell whether the share is equal or not.

Measurement ability is limited to just comparing items in relation to size, height and length. Measurement activities involved comparing amount or volume of drinks and comparing heights and lengths. He could tell that his soft drink has more in it than his sister's. When asked how tall he is, he would either say that he is taller or he is shorter. He knows that he is shorter than his sister, but he is taller than his little cousin. He tells heights by comparing how tall he is with how tall others are. He could also tell that one object is longer than the other. He could tell that her mother's hair is longer than her sister's hair.

His older sister corrects Alik when he makes mistakes. His older sister tried to correct him when he said that he is 3 years old, and he is in 2<sup>nd</sup> grade. His sister told him that he is 3 years old, and he is not in school yet. While he was rearranging the slippers for his sister and his mother, he realized that one slipper was missing. He asked his mother to help him look for the missing slipper. He said he was looking for one slipper. He was saying, sorry se (one slipper) instead of saying one pair of slippers. He was able to count the slippers but not able to tell that the slippers are in pairs.

Alik is able to sort objects based on colors and sizes. He was able to sort roses given based on colors. He was able to tell yellow, red, white, and blue. He was also able to compare sizes of leaves provided and tell which leave is biggest and which is smallest. When provided some objects, he sorted them in three ways.

- Dirty objects belong to a group and clean objects in one group
- Small objects go in one group and bigger objects make another group
- Same color roses go in one group

When Alik was asked to arrange the shoes at the house in order, he tried to organize them based on sizes. His put his shoes first because they are smaller than his father's shoes. He did this after watching his older sister doing the same with the slippers. He collected roses and leaves with kids in the neighborhood and compared his collection with others, and organized the collections from everyone from least to most. Alik is able to tell that groups of objects with more objects are bigger in quantities, but he is not able yet to relate values of numbers with one to one correspondence. Alik does not understand the concept of numbers (numeration and values of numbers). He likes watching his sister writing numbers. He wanted to write, but had difficulty

trying to hold the pencil appropriately, and ended up scratching and scribbling all over the paper he was using.

Alik's errors are often corrected by his parents, and most of the time it is his mother that does the correction and teaching of new words. Sometimes his older sister corrects him from his mistakes, but often times, she is not consciously aware that she is helping him to learn. When Alik says a counting word that is not the appropriate word for counting a particular object, the parents correct him and tell him the right counting word. Alik's parents are generally aware that their child learns from the activities he is engaged in at home and around the neighborhood, however, they have limited knowledge of the mathematics involved in some of the activities that their child is engaged in. They understand that Alik begins her mathematics learning from them especially and from the people at home and in the community. Because of this, Alik learns his foundational knowledge and skills informally and indirectly through the games he plays and through her interactions with his sister, parents, and children in the neighborhood.

After the discussions and conversations regarding preschool mathematics, Alik's mother, who is a lower grade elementary teacher, said that he started paying more attention to the games that Alik plays, and became more interested in helping Alik to learn some basic mathematics including pre-counting and basic counting. He tried teaching Alik to count using concrete, tangible objects such as candies that are available at home. Being a classroom teacher and being able to identify the type of mathematics learning that develops from Alik's activities, Alik's mother has become interested in facilitating Alik's mathematics learning. With the help from Alik's mother, his sister, his matrilineal grandparents, he is able to sort objects, arrange objects in order, compare sizes, lengths, and heights, and rote count up to five. Being around a classroom teacher, a Early Childhood Education student, farmers, and a high school teacher, Alik has a better chance of learning a lot of preschool mathematics prior to his future entry to school.

*Family profile: Alikna family–SiKenye*

Table 3.4

Child Participant Profile	Mother <sup>2</sup> /Guardian’s Profile	Father’s Profile
<p>Name: SiKenye</p> <p>Lives with grandmother most of the time. After school she lives with uncles, aunts, an older brother and a younger sister</p>	<p>Name: SiTulpe</p> <p>Age: 31</p> <p>Highest Grade Completed: 12</p> <p>IHE Completed: COM-FSM</p> <p>Occupation/Work History: Teaching 1<sup>st</sup> Grade for 7 years.</p>	<p>Name: Alikna</p> <p>Age: 31</p> <p>Highest Grade Completed: 12</p> <p>IHE Completed: Palau Comm. College</p> <p>Occupation/Work History: Nursing Aide, Urban Comm. Forestry Coordinator, Fisheries</p>

SiKenye is a 4-year-old girl living most of the time with her patrilineal grandparents. Her mother is a classroom teacher, and has been teaching first grade at Utwe Elementary School for 7 years. Her father began work as a nursing aide, and later became an Urban Forestry Coordinator. He also works at the Office of Fisheries.

Things that the child manipulates

- Explores features and programs on laptop
- Leaves, TV, pebbles
- Laundry at the river (clothes)
- Coloring books
- Flowers
- Pebbles
- Slippers

Mathematical Language used at home by the child, parents, siblings and other members of the family

Story Telling

- Tahakuhnlah kuh sraclihk- putting things in order or sort things
- *Fahklah luhpah kuh lusac*- say sizes and length of things
- *Loes liki, fototo liki*-longer than and shorter than
- *Emet-etok*-first and last
- *Srihklac-yohklac*-smaller than and bigger than
- *Puhs-suhpuhs*-more than and less than
- Grouping and sorting- which ones are first and which ones are last
- Ordinal numbers-first one and last one

#### Mathematical language promoted at home

- *Oracni kuh toeni*-putting together of adding
- *Ekahsr*-how many for questions regarding number of things (quantity)
- *Sraclihk, oracni, oaklah*
- Counting with common counting system-*sie, luo, tolu*
- Sometimes other counting systems-*soko, lukwac, tolkoe*

#### Measurement Activities

- She likes comparing hair length and running races.
- Do parents help with misconceptions? (what kind of misconceptions and what kind of help provided)
- She does not know sequence of days of the week or time of day. Parents help her with correct sequence of days of the week and correct descriptive words for different times of the day.
- *Sra ekahsr ac fihkar ekahsr kom telacni*- how many leaves and how many pebbles have you collected
- *Suc kac loes omet*- who is the tallest-who is the tallest
- Compare heights among siblings
- Ages of siblings
- Sizes (fatter and skinnier)

#### Do parents correct child with misconceptions?

- She usually rote count to five and when asked how many or what the last number is, she says four, so the mother corrects her and asks her to count again to five

- Mother helps when she misses the concepts of using appropriate counting words for the two counting systems
- Mother helps her to understand numbers and number values

Do parents realize that activities are mathematics activities?

- Parents attention and help provided for the child is very minimal. They only pay attention to the mathematics that the child learns incidentally.
- The mother is a first grade mathematicsteacher, so sometimes she recognizes mathematicswithin the child's activities

What are some pre-counting activities?

#### Sorting and Classification

- She always sort things based on likeness in colors or types
- She sorts toys for boys and toys for girls
- Separates clothes for school from other clothes just like her older brother does
- 

#### Matching

- She matches green gums with green gum and red gums with red gum
- Team mates- boy with boys and girl with girls
- Running races-boys team and girls team
- Hairpins, outfits and slippers

#### Ordering

- She can tell the order of questions that she got the answers to correctly
- Number of leaves collected, compare to see who collects the least and ordering collections from least to most.
- She compares heights and tells which is tallest and which is shortest
- Sizes of leaves
- Quantities of eggs

Can the child write numbers?

- Cannot write numerals, but hopes to learn how scores are calculated
- She masters writing 1 and is stuck there.

Does the child understand the concept of numbers (numeration and values of numbers)

- When she sits down to counts objects, she understands that bigger numbers mean more objects
- She can tell written symbols as numbers but does not know number values

What are the child's typical toys?

- She loves playing matching games on her laptop
- Colors and books
- Toys
- She has a toy doctor's set and two teddy bears
- Several toys used when playing and modeling home activities and other community activities including activities at the stores or markets.

*Case study: Alikna family-SiKenye*

The Alikna Family is a five-member family consisting of the parents (mother and father) and three children. The eldest child is a 6-year old boy. The 4-year old female child participant, who we will call SiKenye, is 2 years younger, and the youngest is a 3-year old girl. SiKenye's father is 31 years old and comes from a family of six with him being the eldest in the family. He has three brothers and two sisters. He went to school at the Palau Community College and later became a nursing aide. Currently, he is an Urban Community Forestry Coordinator.

SiKenye's mother is 31 years old and comes from a family of seven with her being the 5th in the family. She has two sisters, one older and one younger than her. She also has four brothers, three older and one younger than him. She went to school at the College of Micronesia-FSM and graduated with a degree in Elementary Education. She began her teaching career at Tafunsak Elementary School teaching first grade mathematics, science, and social studies. Currently, she works at the Utwe Elementary School still teaching 1<sup>st</sup> grade mathematics, science and social studies. She has taught 1<sup>st</sup> grade mathematics for seven years. Aside from her full-time teaching job, she also helps with the Youth Christian Endeavor after class.

At SiKenye's home, there is a cook house and a concrete dwelling house. The dwelling house is a big family house also used by the big family as a gathering or meeting place. A retail store is

located about twenty meters away from the child's home. Across the street from the retail store is community center located about 30 meters from the shore. In the afternoon after work, the people living nearby would get together to play volleyball, basketball, and other indoor games. During the day, SiKenye would sometimes play around the retail store and at the community center. The distance from SiKenye's house to the shore is a five-minute walk. A fringing reef which is one 100 meters away from the shoreline provides a fishing place and swimming area during high tide. When the tide is low, there are tide pools where little fishes, and other sources of seafood could be found. The shore provides a play area where the children could collect sea shells, sand, gravel, and rocks. Fruits from the trees growing along the shore are sometimes used for games. Going a few meters inland, several fruit trees like breadfruits, coconuts, papaya, and bananas could be found. There is a graveyard about 40 meters from the dwelling house. The nearest house neighboring SiKenye's home is about 75 meters away. Several houses are a bit further, but they are all within the neighborhood. SiKenye's home is about 100 meters away from the Utwe Elementary School campus where her mother works.

SiKenye and her little sister stay at home with the other people living with them during the day when her parents are at work. SiKenye and her family lives in the big family house with her father's matrilineal aunt, uncle, and grandmother. The aunt and the uncle stay home most of the time taking care of their mother, who is very old.

While at home, SiKenye spends a majority of her time playing out-doors with her younger sister and another younger girl from the house next door. Sometimes she stays indoor exploring features and programs on a laptop computer. She switches from playing with the computer to watching T.V. and coloring pictures on her coloring book. Outside of the house, she likes playing with leaves and pebbles that she collects around the house. When school is over, there are more children to play with. The games the children in the neighborhood usually play are tagging games, hide and seek, and running races.

SiKenye stays with her grandmother at her patrilineal grandparents' home most of the time during the day when her parents are at work. After work, she is dropped off at her home, which is about 20 minute-drive from her grandparents' house at the farm. Sometimes her parents drive to the farm to pick her up after work. SiKenye's patrilineal grandfather is a classroom teacher at Utwe Elementary School where her mother also works. She sometimes helps with her

grandmother's laundry, which is usually done at the river. The river by her patrilineal grandparents' house is about 50 meters from the house, and it serves as a place for doing laundry and a place for bathing and swimming. In the evening SiKenye goes back home to join the other members of her family.

The mathematical Language used at home by the child, parents, siblings and other members of the family include:

- *Tahakuhnlah kuh sraclihk*- putting things in order or sort things
- *Fahklah luhpah kuh lusac*- tell sizes and length of things
- *Loes liki, fototo liki*-longer than- shorter than
- *Emet-etok*-first- last
- *Srihklac-yohklac*-too small- too big
- *Puhs-suhpuhs*-more than-less than
- *sie, luo, tolu*-one, two, three (Counting with common counting system)
- *soko, lukwac, tolkoe*-one, two, three (Sometimes other counting systems)

Some measurement activities that SiKenye does at home include:

- comparing hair length (she like comparing the length of her hair with her younger's hair. When asked who has longer hair, she would go and stand by her younger sister and compare the length of their hair)
- SiKenye is a fast runner, and she always comes first in running races. (She does not actually measure the distance between each runner, but she compares the spaces between them with words like *loessuhlah*-too far, *fototo*-close).

SiKenye also has a toy doctor's set and two teddy bears, She likes playing the roles of doctor and patients with her toy doctor set. She has other toys that she uses when playing roles of store keepers and customers. SiKenye gets learns things mostly from her mother and her patrilineal grandfather. These two individuals pay more attention to her when she plays or when she is around them. They try to teach her when she does things wrong. She does not know sequence of days of the week or time of day. They help her with correct sequence of days of the week and correct descriptive words for different times of the day. SiKenye's grandfather teaches her how to count, and now she is able to count up to ten without skipping any number. When asked to

count the leaves or pebbles she collected, she would put her finger on the objects and count them up to ten..

SiKenye is able to do some sorting activities at home. When provided some different colored candies, she sorted them based on colors and types. She was able to sort green candies in one group and red candies in the other group. She could also sort her toys and put them into two groups, one group for boys toys and one group for girls toys. She is also able to put clothes for school in one place and puts clothes for church in another place.

SiKenye is able to do some matching games at home. When provided some gums to work with, she was able to match the same number of green gums with the same number of red gums. She was also able to match number of boys with number of girls to make equal teams. She was also able to match hair pins with outfits and slippers.

SiKenye is able to do some ordering activities at home. When asked to put the leaves collected in order, she put the groups of leaves in order from least to most. She was able to line up her friends from tallest to shortest. She was also able to put the leaves in order from biggest to smallest

After the discussions and conversations regarding preschool mathematics, with SiKenye's parents, her mother mentioned that she thinks SiKenye learns from her grandfather, who is a 5<sup>th</sup> grade classroom teacher. SiKenye's mother, who is a 1<sup>st</sup> grade teacher, said that he started paying more attention to the games that SiKenye plays, and became more interested in helping her to learn some basic mathematics including pre-counting and basic counting. He tried teaching SiKenye to count using concrete, tangible objects such as candies, leaves, and other objects that are available at home. Being a classroom teacher and being able to identify the type of mathematics learning that develops from SiKenye's activities, SiKenye's mother has become interested in facilitating SiKenye's mathematics learning. With the help from SiKenye's mother to learn to do pre-counting and basic counting activities, and the help from her grandfather, she is able currently able to sort objects, arrange objects in order, compare sizes, lengths, and heights, and rote count up to ten. Being around a classroom teacher, and around people who pay more attention to a child's early mathematics learning, provides better opportunities, and better

chances for a preschool child learn from pre-counting activities as well as basic counting activities. With the close attention she gets from her mother and the learning she gets from her grandfather, SiKenye seems to be prepared for a smoother transition into formal education.

*Family profile: Tulensa family–SiShra*

Table 3.5

Child Participant Profile	Mother’s/Guardian’s Profile	Father’s Profile
Name: SiShra Tulensa Lives with parents, a brother and a sister both attending secondary school.	Name: Notwe Age: 39 Highest Grade Completed: 12 IHE Completed: COM-FSM Occupation/Work History: Classroom Teacher for 19 years	Name: Tulensa Age: 45 Highest Grade Completed: 10 Pohnpei Agriculture and Trade School (PATs) IHE Completed: N/A Occupation/Work History: Subsistence Farmer

SiShra Tulensa is a 4 year old girl living with her nuclear family of 5 including herself. She has a brother and a sister both attending Kosrae High School. Her mother is a first grade Language Arts teacher, who has been teaching for 19 years. Her father is a subsistence farmer. Aside from farming, he fishes.

At home the child plays with CD players, operates TV, and answers telephone calls. She is also able to dial telephone numbers for some places, such as school and some relatives’ homes. She also listens to music with her I-pod.

Pre-counting activities from researcher’s observations and parents’ diaries?

Sorting

- Sorting different kinds of chocolate candies in a bag
- Sorting hair holding pins in colors
- Sorting Rook card into colors

Matching

- Putting together marbles based on own categories (especially, colors and sizes)
- Recognizing same size earrings,
- Recognize pairs of earrings
- Putting little pins together and big pins together

## Ordering

- Putting bananas in order from biggest to smallest
- Putting dolls in order from longest to shortest
- Putting pencils in order from longest to shortest

Mathematical Language used at home by the child, parents, siblings and other members of the family

- *Eslah,puhs, suhpuhs, yohk, ac srihk* (taking away, more, bigger, and smaller)
- *Sraclihik ilulu luhn mwet mahtuh ac tuhlihk srisrik* (Putting together pillows and separating those for elders from those for the children)
- *Sraclihk nuknuk luhn mwet sahyac* (separating others clothes from hers)
- *Srihk-yohk, fototo-loes, mahtuh-srihk, puhseni-suhpuhseni* (smaller or younger, longer, increasing in number, decreasing in number)

Mathematical language promoted at home

- *Sie, luo, tolu,ahkosr* (the common counting system: one, two, three, four. She can rote count up to four. When given something to count and when asked how many, if it is more than four, the answer will always be four ).
- *Oacwac ma, sie, luo, tolu...10* (she is able to count correctly to 10; however, when asked how many, the answer is four.
- *Soko* (a different counting system used for counting long objects and moving objects. She sometimes switches the use of the two counting systems.)

Measurement Activities

- *Loes liki* ( longer than: When asked how tall she is or how long her hair is, she compares her height with that of other children in the neighborhood. She does the same when asked for the length of hair. Although she knows the concept of tall and short, she uses *loes liki* for describing both longer and taller objects)
- *Ramihme-puhs* (quantity of marbles: she compares the number of marbles she has with the number of marbles the other child has)
- *Luhpan mongo ke ahluh* (Size of food on plates: She always likes to have bigger size of food on her plate. She compares the amount of food on her plate with the amount of food on others' plates.)

What are some kinds of mathematical misconceptions and what kind of help provided?

- *Stosah se* (One car: she switched the use of counting systems. Her mother corrected her with the correct counting system to use for counting moving objects)
- *Yohk luhkwel-loes luhkwel, srihk luhkwel-foto luhkwel* (bigger than, longer than, smaller than, and shorter than: she switched bigger than with smaller than, and shorter than with taller than).
- *Pin in karak se* ( hair pins are counted with inappropriate counting system)

Do parents realize that activities are mathematics activities?

- At first the parents did not realize that some activities that their child is engaged in are mathematics activities. As they began recording their child's activities in their diaries, then they realized that the activities are mathematics related.
- The child's mother mentioned that she began realizing that even distributing the coins for offerings in church could be mathematics learning.
- The child's mother also realized that counting hair pins and making choices of types of hair pins has mathematics in it.

Can the child write numbers?

- The child at this age cannot write numbers.
- The parents consider number writing as something that has to be learned in school alone.
- The child does not understand the concept of numbers and numerals.

What are the child's typical toys?

- The child plays with Baby dolls, balls, and toy guns.

*Case study: Tulensa family–SiShra*

The Tulensa Family is a 5-member family consisting of the parents (mother and father), one brother, two sisters both older than the child participant who will call SiShra. SiShra is a 4 year old girl, and she is the youngest child in the family. SiShra's brother is a Junior student and her eldest sister is a Senior student both attending Kosrae High School. The other sister is 6 years older than SiShra, and she is a 4<sup>th</sup> grader at the elementary school where her mother works.

SiShra's father is 45 years old and comes from a family of six with him being the second in the family. He quitted school after attending the Pohnpei Agriculture and Trade School (PATs). Currently, he is a subsistence farmer, and he raises pigs and plants taros, bananas, tangerines, mangoes, tapioca, breadfruits, and other fruit trees and root crops. SiShra stays with him most of the time at home when her mother goes to work and her siblings go to school during the day.

SiShra's mother is 39 years old and comes from a family of 8 with her being the 3<sup>rd</sup> in the family. She got her A.A. degree in Liberal Arts at the Community College of Micronesia-FSM. After graduating from college, she began teaching at Utwe Elementary School. She has taught at Utwe Elementary School for 19 years, teaching 1<sup>st</sup> grade Language Arts.

At SiShra's home, there is a cook house and a concrete dwelling house. The front yard is about 15 meters from the main road. The front yard is a popular play area for the children in the neighborhood. SiShra's home is situated in town, where there is a store, a fuel station, and more residential areas surrounding their house. The store is located about fifty meters away from the child's home. I had my observations in the afternoon when school and work are over, and the school children returned from elementary and high school, and her mother returned from work. SiShra was playing a game called "Red Rover" with friends in the neighborhood. Three of her friends are a year older than her and one is a year younger. In this game, one child runs and tries to break a chain of other children grabbing hands tightly and strongly in order not to let the children running towards them break the chain of hands. If the child got through the chain, she claims the two children at the weak point or broken part of the chain. The other two grab hands again and the other group decide on one child to run and try to break the chain again. If the child fails to break the chain, then she is claimed by the opposing team. The objective of the game is to break all the parts of the chain and claim the opponents otherwise if the opponents keep the chain and claim all who run and fail to break the chain, then they win. Four children were playing with SiShra, and then her mother came and joined them. SiShra's mother asked the children to count the number of children holding hands intentionally so SiShra could hear them counting. She stopped one time and asked SiShra to count the number of children playing with her. SiShra pointed to the four children playing with her and counted them correctly. The children played this game with SiShra for over one hour and then stopped and rested at the front port of their

house. While resting at the front porch, SiShra's mother gave the children candies. She gave SiShra five candies and asked her to tell her how many candies she has. SiShra touched the candies, counted the candies and said four. She is not able to count beyond four. Although SiShra is able to count up to four, she still needs a lot of pre-counting knowledge in order to do basic counting better.

SiShra's brother who is a lot older than her seemed less interested in the games that the children were playing. Her older sister was just watching and laughing at the children. The other sister who is six years older than SiShra watched the children playing for a while and then walked away to join her friends. Since her other siblings were not paying much attention and were not participating in the game, I focused my observations on SiShra's interactions with the children she was playing with and her mother to learn about the languages she was using and to collect data on her pre-counting and basic counting knowledge. Indoor, SiShra played with a CD player, operated TV, and answered telephone calls. She is also able to dial telephone numbers for the school where her mother works and for some of her relatives. She was also able to operate her I-pod and choose music on it to listen to.

The common mathematical language spoken at home involves basic counting words (numbers) and comparison words. When comparing items, SiShra often compares the items she possesses with others. When given candies to count, SiShra touched one candy at a time with her finger and counted them. She was able to count the candies from one to four with correct number words using the common counting system (*sie*-one, *luo*-two, *tolu*-three, *ahkosr*-four). She has difficulty counting on from four.

Mathematical Language used at home by the child, parents, and her siblings include *Eslah*-taking away from. When asked to help arrange things in the house, SiShra would separate or sort pillows for her parents and pillows for the children and put them in two separate places. She would put her own clothes away from her brother and sisters' clothes. She uses words like *puhs* and *puhkantwen* to tell that she has many and more clothes in the stack of clothes folded in the house than those of her sisters. She would use words like *suhpuhs* to say that her sisters have fewer clothes. She is also able to differentiate big and small objects, and long and short objects.

SiShra is strangely able to rote count to ten, but she is not able to actually count on from four. She could only count up to four objects with *sie, luo, tolu, ahkosr* (the common counting system: one, two, three, four). However, If given something to count and say how many, her answer will always be four (*ahkosr*), even when there are more than four. It seems that she memorizes counting to ten, but she is unable to do actual counting beyond four when provided objects to count.

Some of the things that SiShra was able to sort at home were chocolate candies, hair pins, and playing cards. She was given some chocolate candies, and she sorted them into three groups based on shapes. She was given some black hair pins and some blue hair pins, and she sorted the hair pins into two groups based on colors. The playing card stack has different colored cards, some green, some yellow, some black, and some red. SiShra was able to sort the cards into four groups based on colors.

SiShra did not do much matching activities, but she was able to put together marbles that are the same color and then put marbles that have the same size. She was not able yet to match marbles to numbers although she is able to count the marbles up to four. She is able to match earrings; however, she is not able to correctly tell whether two groups have same or different number of earrings. She is able to sort pins into different groups, but is not able to match pins in a set to equivalent number of pins in other groups. She is able to tell the differences in colors and sizes, but she is not able to match objects that are equal in numbers.

If SiShra is able to sort objects given, is she able to put them in order? This was the question I had in mind when observing SiShra. She was given three bananas to put them in order from biggest to smallest, and she was able to put them appropriately in order. She was able to say that the first one is the biggest-*yohk emet* and the last one is the smallest-*srihk emet*. She had four dolls and when asked to put her dolls in order, she put them in order from longest to shortest. She was able to say comparative words like *loes emet*-longest and *fototo emet*-shortest. She did the same with the pencils provided. She was able to sort objects based on colors, shapes, lengths,

and sizes, and this correlates to her being able to put objects given in order from biggest to smallest or longest to shortest.

SiShra's measurement activities are limited to comparing height, length, and size of objects. When asked how tall she is, she compares her height with the heights of other children in the neighborhood. She would use words like *loes liki* to mean she is taller. When asked how long her hair is, she uses comparative words like *loes liki*-longer than and *foto to liki*- shorter than to tell how long or how short her hair is. Although she knows the concept of tall and short and long and short, she is not able to use any unit for measuring, instead, she uses *loes liki* for describing both longer and taller objects. She does not actually measure her height and the heights of the other children but uses her own height to compare with others' height. She does the same when comparing the length of her hair. She has little knowledge about volume of food, but she is able to recognize that some food servings are big and some are small. She always likes to have the bigger share of food. She uses comparative words like *yohklac*-too big and *srihklac*-too small to tell the amount of food she has as compared to the amount of food others have.

SiShra's errors are often corrected by her parents, especially her mother and her sisters. When SiShra says a counting word that is not the appropriate word for counting a particular object, the parents correct her and tell her the right counting word. SiShra was asked to tell what she saw passing by on the road, and she said, *stosah se*, which is not the right word for one car. Her mother corrected her and told her that most moving objects are counted differently, and one car should be counted with *soko* but not *sie*, *Soko* and *sie* both mean one, but they are used differently, depending on the type of object being counted. SiShra was asked to count several objects (candies, hair, pins, dolls), and every time she counted, she miscounted after four and her mother asked her to count again starting from one. Counting is taught by SiShra's mother in this way. By age four, a child is expected to be able to count from one to ten correctly. Although SiShra is able to rote count up to ten, but she is not able to count objects beyond four.

SiShra's parents are generally aware that their child learns from the activities she is engaged in at home and around the neighborhood, however, they have limited knowledge of the mathematics involved in some of the activities that their child is engaged in. They understand that SiShra begins her mathematics learning from them especially and from her exposure to activities in the

neighborhood and around the community. SiShra learns her foundational mathematics knowledge and skills informally and indirectly through the games she plays in the neighborhood and through her interactions with her siblings, parents, and peers.

After the visits and the observations with SiShra, her mother expressed her deep appreciations for involving their child in the study. SiShra's parents both openly discussed about the mathematics learning that they themselves were able to observe from the activities that their child were engaged in. SiShra's mother, who is a 1<sup>st</sup> grade Language teacher, said that she became interested in knowing how much pre-counting knowledge as well as basic counting knowledge their child is building through her interactions with peers and other people in the neighborhood. She starts paying more attention to the games that SiShra is plays, and begin to spend more time after school with SiShra. She is aware now that SiShra could only count objects up to four and that she has difficulty counting objects on from four although she is able to rote count to ten. She begins to provide more opportunities for SiShra to count using concrete, tangible objects such as candies, toys, and other objects that are available at home. She mentioned that she has even realized that counting hairpins and choosing which to wear is mathematics learning. Being a classroom teacher and being able to identify the type of mathematics learning that develops from SiShra's activities make the difference in her mathematics learning development. SiShra's father is also convinced that SiShra would be better prepared for school if she is provided with more opportunities for her to indirectly develop her mathematics knowledge through games and other activities in the neighborhood as well as in the community. He mentioned that even distributing coins every Sunday for his children for offerings in church could be indirect mathematics learning.

## DISCUSSION AND RECOMMENDATIONS

Mathematics is a way of thinking about problems and issues in the world. Get the thinking right and the skills come largely for free. It is not that people cannot think mathematically. It's that they have enormous trouble doing it in a de-contextualized setting (Devlin, 2010, p. 10).

The opportunity presented when learning begins in the home is that the mathematics knowledge is developed in context, and is therefore immediately meaningful. Early mathematics in this study refers to mathematical knowledge and concepts learned prior to formal mathematical learning in school.

At the homes and the communities where preschool children are born and reared, the environment including children, younger boys and girls, older people, home and community activities, the materials used at home including imported things, and all the surroundings of the homes and community all contribute to the mathematics learning development of preschool children. Preschool children learn new mathematics knowledge and build on this knowledge as they interact with the boys and girls in the neighborhood including their brothers and sisters. When playing games with the little boys and girls in the neighborhood, they pick new words adding to their vocabulary. Some of these words became to be used as parts of the mathematics language used in preschool children's games and household chores. They also learn from pre-counting activities such as sorting and ordering children and places in running races, simple measuring activities like telling distances in marble games, and matching groups of object with other equivalent sets.

One factor influencing young children's learning in the way in which they are reared. In Kosrae when children are born, they live with their matrilineal families for a period not sooner than one month. Later when they grow older, they are brought back to their patrilineal families. Fathers' are responsible to find food for the family while mothers cook and take care of the children. Usually the mothers spend most times with the babies than the fathers; therefore most learning is from the mother..

Other people in the neighborhood including those living with the research participant have some indirect influences to the child's mathematics learning. Children learn new words when they hear them used by other people living with them in their homes, and from other people in the community. The child picks up new mathematical knowledge from listening to older people and from watching them do things.

#### *Research question 1*

When does the development of mathematics knowledge begin at home? What kind of mathematics knowledge and skills are gained and at what age?

In Kosrae my study makes it clear that the development of mathematics knowledge begins early in the homes before children receive formal education in school. Preschool children, ages 3 and 4, have already gained some mathematics knowledge and begin building on their mathematics knowledge from pre-counting activities such as comparing and measuring heights of their friends, cousins, or brothers and sisters. Preschool children also learn to put things in order based on sizes, colors, and shapes. They are able to sort the leaves they collect and play with into groups based on colors and shapes. They are able to sort round leaves from long leaves, and yellow leaves from green leaves. Almost all the children could count from one to five. Some preschool children could rote count to ten, but when it comes to actual counting such as counting concrete objects, they struggle because they have not been provided the opportunity and practice to do actual counting.

#### *Research question 2*

What impacts do the educational levels of parents have in the mathematics learning of their children?

Three of the children studied have mothers who have taught in elementary school for over five years. These children perform better with pre-counting activities than those with parents that do not have teaching experiences. Parents with education backgrounds and have some years of teaching experience showed more interest in the activities that their children are engaged in that

may lead to their children's mathematics learning development. They began to pay more attention to mathematics learning that come from the activities that their children are engaged in. Although other parents become aware of the fact that their children start developing mathematics knowledge in their homes and that the knowledge and skills learned in the homes could help prepare children for a smoother transition into formal mathematics education, it became evident that the more education parents had the more likely they were to engage in mathematical talk with their children.

### *Research question 3*

What impacts do siblings at the elementary level have in the mathematics development of the participant?

In those homes where there are siblings in school, the child studied knew more about school and what happened at school and was probably better prepared for school. In one of the case studies, Alik Nena is a year younger than his sister who attends Kindergarten, and he copies school related activities that his older sister does at home. In school, Kindergarten students do short speeches, telling their names, the names of their father and mother, how old they are, and what they want to do when they grow up. Alik Nena learned to do his own speech after listening to his sister doing her speech. In another case study, SiKenye showed her ability to tell up to four different colors of objects and compare shapes and length of objects, These were school activities that she learned from her brother when he worked on his school homework, which involved identifying different colors, and comparing shapes of objects and measuring length of objects. In the homes where Aliksru and Tulpe lives, there are no siblings attending school, and these children makes more errors in basic counting and could not even rote count to ten. Preschool children imitate the things that their brothers and sisters who are in school does for school. In regards to mathematics learning, children studied learn basic counting from listening and watching their older siblings count.

### *Research question 4*

What are the teaching and learning approaches?

I observed both direct instruction and informal learning in all the homes. In my observation on Tulpe, she was with her cousin. They were engaged in two activities, and were switching from watching TV to playing volleyball, but most of the time they played volleyball with a balloon. My observations were focused more on directional words from pre-counting and basic counting activities. They were only counting the number of times they hit the ball and did not count all attempts to hit the ball that missed. They understood directions of up and down, and they took turns hitting the balloon and trying to keep the balloon in the air. They were using words like “*lucng*” meaning up and “*ten*” meaning down. At one time they were counting the number of hits on the balloon together as they were taking turns hitting. They were counting by tens, but started with 30. Tulpe started counting with 30 and then 40. She skipped 50 and counted 60. It seemed like the child has learned to skip count by tens, but does not understand values of numbers. There was no interaction from Tulpe’s mother or her cousin’s mother. They were left alone to play and learn by themselves.

The second observation on Tulpe was done on an evening while she was home with her mother, aunt, and her older brother and younger sister. I provided guided instruction and tried to collect data on how Tulpe would sort objects and seriate objects. I brought some candies for her to use to answer questions relating to grouping and sorting by colors, shapes, and sizes. Tulpe was asked first to sort candies based on color, and then shapes, and then sizes. Tulpe was able to sort candies by colors (*sruhsrah*-red, *folfol*-blue, and *ranrang*-yellow), She was able to sort candies by shapes. She was able to differentiate round candies from long candies. She understands *raun*-round, and *loes*-short.

Tulpe was then asked to seriate items based on sizes and lengths. She was able to seriate five items from smallest (*srihk emet*) to biggest (*yohk emet*) and from shortest (*foto to emet*) to longest (*loes emet*),

In another guided instruction, Aliksru was asked to answer questions relating to basic counting. When asked to show one, he raised one finger, and when asked to count the dogs, he pointed to one dog and said *kosro soko*, which means one dog. He knows that one finger represents one and one dog also represents one. Although, he knows that there are three dogs, when asked to count them all, he counted the second dog as another dog instead of counting on from one to two. He counted the third dog likewise as another dog. Alik's parents asked him to do his memorized speech, and he started saying his name, his father's name, his mother's name, his favorite food, and what he want to be when he grows up. When asked how many packs of cool aid he tore in the car, he said, "*ma sie fanna*" (there is only one).

Direct instruction happens when a child says a word incorrectly or does something inappropriate. Tulpe's errors are often corrected by her parents, and most of the time it is her mother that does the correction and teaching of new words. When Tulpe says a counting word that is not the appropriate word for counting a particular object, the parents correct her and tell her the right counting word. Tulpe was asked to tell how many dogs there were, sitting by the door, and she said *kosro se*, which is the incorrect word for one dog. Her mother corrected her and told her that most animals are counted differently, and one dog should be counted with *soko* but not *sie*, *Soko* and *sie* both mean one, but they are used differently, depending on the type of object being counted. Tulpe was asked to count several objects (candies, shells, dogs), and every time she counted, she miscounted after seven and her mother asked her to count again starting from one. Counting is taught by Tulpe's mother in this way. By the age of four, a child is expected to be able to count from one to ten correctly. Although Tulpe is able to rote count up to seven, she is unable to do actual counting of objects. Aliksru's guardian and her aunt understand that Aliksru learns to count and tries to count, and when he makes a mistake in counting, they try to correct him, but they pay little attention to his mathematics learning. Alik's errors are often corrected by his parents, and most of the time it is her mother that does the correction and teaching of new words. Sometimes his older sister corrects him from his mistakes, but often times, she is not consciously aware that she is helping him to learn. When Alik says a counting word that is not the appropriate word for counting a particular object, the parents correct him and tell him the right counting word

- d. Direct Instruction
- e. Indirect or informal learning
  - i. learning from watching
  - ii. games
  - iii. story-telling
- f. Parent-assisted learning
  - i. Doing household chores
  - ii. Farming activities
  - iii. Fishing activities

Bringing together a group of parents to talk about mathematics activities and learning of their preschool children is a new initiative that would help better prepare children prior to their entry into formal schooling. Parents should be made aware of the importance of their role in the early development of their children's understanding of mathematics. During the final meeting with the parents they were asked again to list down all the activities that they have seen their children engaged in that may have some influences to their children's mathematics learning. They decided to have their discussions on the mathematics language the children are using at home and the measurement activities that they do. Below are the words they listed down as commonly used by their children:

- *Puhkantwen*- plenty
- *Suhpuhs*-few
- *Yohk*-big
- *Srihk*-small
- *Met liki*-infront of
- *Tok liki*-behind or after
- *Sie, luo, tolu*-one, two, three
- *Tahfuh*-half
- *Fohn*-whole
- *Pal*-thrown or jumped long distance

- *Suhpal*-not thrown or jumped long distance

The measurement activities the parents see their children do in their homes are listed below.

- Teapot and bottle water-when children play with teapots and bottle water, they use other small containers to either fill up the big containers(teapots and water bottles) or pour out the contents of the big containers (teapots and water bottles) into the small containers. This is believed to be an activity that may lead to the understanding of the use of units of measurement. The children describe contents of containers by using words like *wacngihnlac*-no more, and *oasr koano*- there is water in it.
- Torino- when the children play with marbles, they are able to tell distances that their marbles would go when they hit or throw them. The children describe distances with words like *pal*-long distance, and *suhpal*- not long distance.
- Luhpan nuknuk-sizes of clothes- The children are able to compare sizes of clothes they wear or given to wear. The children describe sizes of clothes with words like *yohklac*-too big, and *srihklac*-too small.
- Akuhtuhn-running races. The children play running races, and when they get to the finish mark, they are able to arrange themselves in order from first to last based on the order in which they reach the finish line. They are able to use words like *met*-first, *tohkoh*-after, and *etok*-last.

The parents also mentioned that their children do a lot of sorting activities at their homes including sorting leaves by sizes and colors, sorting candies based on colors and shapes, and sorting other children playing with them by gender.

After participating in the study, the parents became aware that early mathematics learning begins in the homes through preschool children's interactions with people in the homes, including parents, siblings, people in the extended families, relatives, peers, and other children in the neighborhood and people in the community as well. The parents have expressed their interest in learning more about activities that might have some impacts on the mathematics learning development of their children. In fact, they even said that they have already begun teaching their preschool children to do pre-counting and basic counting correctly. They begin to pay more attention to the activities and games that their children are engaged in. They have provided their children help and assistance in their early mathematics learning, and have seen the mathematics learning that is developing in their children.

Currently, schools have Parents and Teachers meetings and workshops for parents of school children, and have never done anything for parents of preschool children. Schools in Kosrae should begin reaching out into the homes of preschool children, and learn about the activities that children are engaged in, which have impacts to their early mathematics learning development. Parents of preschool children should be brought together to share and discuss ways that preschool children learn early mathematics in the homes and ways that preschool children could be better prepared for formal schooling, not just in the area of mathematics but also in all subject areas.

Teachers, especially Kindergarten teachers and early grade teachers should have some training in working with parents of preschool children in early mathematics learning in the home.

There should be workshops created by schools at times convenient to parents to discuss early mathematics learning including pre-counting activities and basic counting activities to help their children learn better and in order to have a better preparation for formal learning in school. In this way children would enter school with adequate pre-counting and basic counting knowledge necessary for a better transition from the learning in the homes to the formal learning in school.)

## APPENDIX I

The questions below were used as guides for the discussion.

1. Could you tell a short history of your mathematics learning experiences beginning as far back as you can recall? (Home, Preschool, elementary, secondary, higher institution).
  - a. Home (Age 5 and below)
    - i. What were the kinds of mathematics learning at home (individual, pair, group, and peer)?
    - ii. How did you learn mathematics at home?
    - iii. Whom did you learn mathematics from?
    - iv. Where did you learn mathematics at?
  - b. Kindergarten
    - i. What were the mathematics learning activities?
  - c. Elementary
    - i. What were the mathematics learning activities?
    - ii. What were the mathematics contents and skills learned?
  - d. Secondary/High School
    - i. What were the preferred mathematics subjects?
    - ii. What were the challenging mathematics subjects?
  - e. Post Secondary
    - i. What was the last mathematics course taken? What are the mathematics skills you are comfortable with, and what are have you struggled with.

## APPENDIX II

### Family profiles not used for case studies

Child Participant Profile	Mother'/Guardian's Profile	Father's Profile
<p>Name: Shrue Kilafwa</p> <p>Lives with extended family including grandparents, uncles, aunts, cousins, and brothers and sisters</p>	<p>Name: Kenye</p> <p>Age: 41</p> <p>Highest Grade Completed:12</p> <p>IHE Completed: N/A</p> <p>Occupation/Work History: Housewife</p>	<p>Name: Kilafwa</p> <p>Age:40</p> <p>Highest Grade Completed: 12</p> <p>IHE Completed:COM-FSM, Palau Community College</p> <p>Occupation/Work History: DD&amp;E/DT&amp;I - Engineer</p>

Shrue is a 4-year-old girl living with her nuclear family, but spends most of her time with the patrilineal grandparents whose house is adjacent to her house. Her mother stays with her at home and works as a house wife. Her father works at the Department of Transportation and Infrastructure as an engineer.

#### Things that the child manipulates

- The child likes to watch T.V.
- She has a box for storing toys and games

Mathematical Language used at home by the child, parents, siblings and other members of the family

- Siepac-another one
- Sulpac- again
- Nohfohnna- all
- Siena- different one

- Ma se- one thing
- Puhkantwen- numerous or alot
- Suhpuhs- few
- Nak sie- May I have one (food)
- Nak kuhtuh- May I have more (food)
- Oracni- put together
- Oraclihk- separate things

Mathematical language promoted at home

- Common counting words: sie, luo, tolu, ahkosr, limekosr (one, two, three, four, five)
- Comparing and sharing- She likes to compare what she has or owns to those her brothers and sisters have or own. She likes sharing toys with her friends in the neighborhood.

Measurement Activities

- Compares amount of food served.
- Compares sizes drinks
- Compare bigger clothes and smaller clothes
- Likes to get more share of things distributed among her siblings

Do parents help with misconceptions? (what kind of misconceptions and what kind of help provided)

- Parents help when the child puts up different numbers of fingers for a different number.
- When the child miscounts, the parents correct her and ask her to count again

Do parents realize that activities are mathematics activities?

- The parents allow their child to play roles of customers and store keepers and believe that the child's games and playtimes have some influences to the child's mathematics learning

What are some pre-counting activities?

Sorting

- Sorts candies based on colors

Matching

- Matches pairs of slippers and shoes
- Matches clothes based on colors and sizes

### Ordering

- Puts toys in order from smallest to biggest

Can the child write numbers?

- Although she is able to rote count to five, she cannot write any number, but likes watching her brothers and sisters writing numbers.
- 

Does the child understand the concept of numbers (numeration and values of numbers)

- She differentiates quantities of objects but cannot relate them with written numerals.

What are her typical toys?

- Toy animals
- Slippers
- Marbles
- Papers

Child Participant Profile	Mother'/Guardian's Profile	Father's Profile
Name: Aliksa Tulenkun Lives with extended family including grandfather, uncles, aunts, cousins, and brothers and sisters	Name: Shra Age: 30 Highest Grade Completed:12 IHE Completed: N/A Occupation/Work History: Housewife	Name: Tulenkun Age:36 Highest Grade Completed: 12 IHE Completed:COM-FSM, Community Virtual College, US Army Trans. School, Non Commision Officer Corp., ECPI University Occupation/Work History: Mechanical Engineer Aviation Mechanic Environment Education - Coordinator

Aliksa is a 3-year-old boy living with an extended family. His mother stays at home and works as a house wife. His father works at the Kosrae Island Resources and Management Authority as an Environment Education Coordinator.

Things that the child manipulates

- Bicycle, telephone, TV, things bought from the store

Mathematical Language used at home by the child, parents, siblings and other members of the family

- *Loes*-long
- *Fototo*-short
- *Yohk*-big
- *Srihk*-small
- *Facttoro*-fat

- *Puhkantwen*-numerous
- *Suhpuhs*-few

Mathematical language promoted at home

- Common counting words: *sie, luo, tolu, ahkosr, limekohsr* (one, two, three, four, five)
- *Ma ekahsr-puhkantwen* (how many-a lot)

Measurement Activities

- Compares sizes of drinks: small-big
- Compares heights and sizes

Do parents help with misconceptions? (what kind of misconceptions and what kind of help provided)

- Parents help correct child when he uses different counting words for counting, for example dogs are counted with *soko, lukwac...*, but not *sie, luo*.
- When the child miscounts, the parents correct him and ask him to count again

Do parents realize that activities are mathematics activities?

- Yes, when words like more, less, few, many, big, small, etc..., are used, parents know that the child will be learning to say the same words in addition to other mathematical terms when he gets to school.
- Any activity involving pre-counting or counting is viewed by parents as mathematical learning activities.

What are some pre-counting activities?

Sorting

- Sorts candies based on colors

Matching

- Understands pairs: when one pair of slippers is missing, he will look or ask for it.

Ordering

- Puts objects in order from smallest to biggest

Can the child write numbers?

- Although he is able to rote count to five, he cannot write any number, but likes watching her brothers and sisters writing numbers.

Does the child understand the concept of numbers (numeration and values of numbers)

- The child differentiates quantities of objects but cannot relate them with written numerals.

What are his typical toys?

- Bicycle, sticks, ball, marbles, stones, basketball

Child Participant Profile	Mother'/Guardian's Profile	Father's Profile
Name: Tulen Kun Lives with extended family including grandmother, uncles, aunts, cousins, and sister	Name: Tulpe Age: 26 Highest Grade Completed:12 IHE Completed: COM-FSM Occupation/Work History: Housewife	Name: Kun Age:26 Highest Grade Completed: 12 IHE Completed:COM-FSM Occupation/Work History: PREP-Health Educator

Tulen is a 4 year old boy living with an extended family including grandmother, uncles, aunts, and cousins. His mother is 26 years old, who stays and works at home as an housewife. His father is an Health Educator .

Things that the child manipulates

- TV, games, computer laptop, ipad

Mathematical Language used at home by the child, parents, siblings and other members of the family

- Counting systems
  - *Soko* (ex. one pig) counting system for long objects including moving objects.
  - *Sie* (ex. one house) common counting system
  - *Kuhtuh*-some
  - *Puhkantwen*-more
  - *Loes*-long
  - *Fototo*-short

Mathematical language promoted at home

- Common counting words: *sie, luo, tolu, ahkosr, limekohsr*

Measurement Activities

- He can tell whether the amount of food served for him is bigger or smaller,
- He likes to have more toys than his cousins'

Do parents help with misconceptions? (what kind of misconceptions and what kind of help provided)?

- Parents help correct child when he uses different counting words for counting. For example dogs are counted with *soko, lukwac...*, but not *sie, luo*.
- When the child miscounts, the parents correct her and ask her to count again

Do parents realize that activities are mathematics activities?

- Parents are aware that their child will soon get to school, so they pay more attention to activities that have some relation to school subjects and most of the time activities involving counting, comparing, and sharing

What are some pre-counting activities?

Sorting

- Sorts objects based on colors and sizes

Matching

- Matches small toys with groups of small toys and matches big toys likewise

### Ordering

- Puts objects in order from smallest to biggest

Can the child write numbers?

- Although he is able to rote count to five, he cannot write any number.

Does the child understand the concept of numbers (numeration and values of numbers)

- He differentiates quantities of objects but cannot relate them with written numerals.

What are the child's typical toys?

- toy animals, guns, ipad games, clothes for playing superman

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