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# Cultural Games in Ghana: Exploring Mathematics Pedagogy with Primary School Teachers

by

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**Abstract**

Games in the Ghanaian curriculum are innovations requiring a change in pedagogical practice. In this study, I investigate primary school teachers' experiences and perspectives with the use of common and cultural games in the mathematics classroom. I use craft knowledge, which intertwines knowledge and practice, as an interpretive framework to investigate and analyze the data collected.

Through a survey of 156 teachers, I collected information on teachers' experiences with games at home, in school, and in practice, and on teachers' perspectives of the advantages and disadvantages of using games. Based on the survey, ten teachers (seven users and three non-users) were selected for in-depth conversational interviews (IDCIs) to further explore their experiences and perspectives of using games in the mathematics classroom.

Quantitative analysis of the survey indicates that teachers viewed games in the community as opportunities for social interactions, motivation, cognitive development, moral development, acquisition of cultural knowledge, and physical development. Teachers' perspectives of the advantages and disadvantages of using cultural games were classified into four similar categories. The study showed that although teachers view games as advantageous for learning mathematics, less than 7% of teachers' experienced game use at pre-service and in-service opportunities. Although approximately half of the teachers used games to teach mathematics, less than 23% participants used cultural games. The qualitative analysis indicates that teachers are aware of games in mathematics education curriculum and have rich experiences in their communities, but they had conflicting views as to what constitutes a game, limited knowledge of the

mathematics in cultural games, minimal professional development related to game use, and no resources to draw from.

Cultural games in the mathematics classroom have the potential to promote indigenous mathematics, aid curriculum relevance, and help children cross the divide separating school mathematics and cultural knowledge. However, several obstacles were identified that currently stand in the way. The obstacles, possibilities and implications of the study were discussed in the final chapter through three primary sources of craft knowledge including experiences, current teaching situation, and vision of games as instructional tools.

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# CHAPTER I

## BACKGROUND TO THE STUDY

Ghana, a sub-Saharan country in West Africa, has a population of about 19 million people. It is bounded at the South by the Atlantic Ocean, the West by Cote d'Ivoire, the North by Burkina Faso and the East by the Republic of Togo. Ghana is divided into ten administrative regions. My journey began in the Upper West Region in a rural community, Kaleo-Zangbogu where I was born. Inhabitants of the community live by subsistence farming. As a typical Ghanaian community, it is endowed with rich cultural games and playing games was a natural part of the cultural life of the community. The games served as a major source of entertainment and I played games with peers and adults alike. Through the interactions in playing games I gained many experiences such as counting, strategizing, problem-solving and competing among others. Popular games in the community included *daha, bisogi, kuriyee-kuriyee, baa, bombo, puonãã, oware* and *ampe* among others. Games are popular with both boys and girls. Although some games are stereotyped as either boy or girl games there is nothing that prevents either gender from playing a game.

All the games mentioned above involve some form of mathematics. For example, *daha* is a game of strategy played by two players (using pebbles of two different colours). The players begin by digging a six by six array of holes of about two centimetres radius and two centimetres deep in the ground. Player A has 12 pebbles of one colour and player B has 12 pebbles of another colour. There is no advantage as to who starts. Players take turns to 'sow' or place their 12 pebbles in the holes in the ground

one at a time. When sowing the pebbles a player may not have more than two pebbles of the same colour in a row. After all 24 pebbles are sown, 12 empty holes remain. The goal is to acquire three pebbles of the same colour in a row. Players take turns moving a pebble one space horizontally or vertically. When a player gets three pebbles in a row (vertically or horizontally), they acquire a "shot" or a score and they remove one of the opponent's pebbles. The game continues until all of one player's pebbles are removed (one by one) or the opponent concedes defeat. The only other rule in this game is that you may not have four pebbles of the same colour in a row, which creates a foul, termed *vialla*. If this happens all four pebbles are taken away by the opponent. This challenging game involves counting, one-to-one correspondence, cardinal numbers, patterns, strategizing, and problem solving.

Looking back, as a child I valued playing games and the playing materials more than anything else. Games provided me company and joy, and playing them with friends helped me learn cultural values and mathematical systems in a meaningful way. I played many games while I was growing up. These were an important aspect of my life through which I experienced a dynamic "curriculum of life" prior to formal schooling (Jackson, 1992, p. 8).

In Ghana, the school culture bore little resemblance to my curriculum of life at home. At school, I was suddenly confronted with and forcefully inducted into a new curriculum, a "book curriculum." For me, learning mathematics within this curriculum was associating some names to symbols which were called "numbers" in the English language. English was a foreign language that I knew nothing about as I spoke *Dagaari* at home. The unfamiliar mathematical language held little meaning for me and I had to

struggle to understand. Learning the number system in the school milieu was simply parroting the string of number names after the teacher. I learned to rattle the number names meaninglessly by rote. It took me a great deal of time to gain meaning from this 'book curriculum' because there was a gulf between what I was learning and the knowledge with which I arrived at school. My cultural mathematical systems acquired through playing games did not seem to be taken into account, and games were never used in the mathematics classroom. Yet, it was these cultural tools that made me functional in the cultural mathematical community. For example, when I began primary one (grade one) I was adept at counting to 24 and using mathematics embedded in the cultural games. Unfortunately, this mathematical knowledge and my *Dagaari* language seemed to have no place in the mathematics classroom. For example, my community used a base 20 counting system. The number 36 was represented orally as "twenty and ten and six." However when I used this mathematical language in school, my ideas, at best, received a mere verbal comment acknowledging my contribution but they were never discussed. In fact, often students were laughed at for using different mathematical language than that of the teacher. Teachers probably did not know what to do with this cultural knowledge. Looking back, I felt that my cultural knowledge was marginalized in school.

## The Origin of the Mathematics Curriculum in Ghana

From the earlier beginnings of formal education with the missionaries, the school system recognized the importance of mathematics introduced in the form of arithmetic (Pecku, 1998). By 1920 when the British had gained control of the colony from the missionaries, they established the British educational system (Adjepong, 1996). Ghana,

therefore, inherited a British colonial hegemonic legacy and mathematics education, an imprint of Western thought. Although Ghana attained independence in 1957, my observations are that classroom practice has remained deeply rooted in the traditional British mode.

Mathematics in the colonial educational system focused solely on arithmetic procedures. The educational provisions failed to recognize the wealth of mathematics that existed in the culture and that pupils already possessed. However, between the 1950's and 1960's when many African countries gained independence, the newly independent African states sought culturally relevant educational systems to replace colonial educational systems. As a result, the African Mathematics Program (AMP) was inaugurated in Accra in 1961 under the auspices of the Education Development Centre (EDC), a non-profit organization identified with curriculum change in the United States and South America (Mereku, 2000). Policies of the AMP were aimed at integrating African, American, and British educators in English speaking African countries to influence mathematics education in Africa. The AMP project was popularized through workshops organized at Enttebe in Uganda and Mombassa in Kenya. The outcome of the Enttebe workshops was the production of the Modern Mathematics Series, consisting of different textual materials for pre-university education (Mereku, 2000). The Enttebe materials, according to Mereku (2000) were pilot-tested but their implementation was delayed because of criticisms that the materials were irrelevant to the African context. *Sets* and *operations on sets* were used to develop the entire school arithmetic with misplaced emphasis on advanced concepts, and the language of the materials was viewed as too complex. It was then in response to these criticisms that two regional programs,

The West and East African Regional Mathematics Programs (WARMP and EARMP) were inaugurated to modify the existing schemes in 1970. These programs led to the national production of derivatives of the Enttebe materials for the participating countries (Ghana, Sierra Leone, Liberia, Kenya, and Ethiopia).[1]

With increasing rapid globalization, many African countries recognized the danger of losing their cultural knowledge. In 1974, the inherited British colonial school system of education was criticized as quantitatively elitist and qualitatively inadequate, while teaching remained alien to the reality of children's lives (Adjepong, 1996; McWilliam & Kwamena-Poh, 1975; Pecku, 1998; Thiam, 1986). Following this myriad of criticisms, in 1972 the Dzobo committee was set up to address the concerns raised. The Dzobo committee's recommendations entitled, "The new Structure and Content of Education," (Ministry of Education [MOE], 1974), set the pace for a major comprehensive education reform in Ghana. The reform sought ways that would improve the educational system and make it more relevant and meaningful to Ghanaians. However, it was not until 1987 that the Dzobo committee's recommendations were implemented.[2]

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[1] The materials from WARMP were subsequently re-edited by Ghanaian officials and adapted for Ghanaian schools under the banner of Ghana Mathematics Series (GMS). The GMS books, Teachers Guides, and the Teaching syllabus reflecting the Enttebe materials developed under the auspices of the Curriculum Research and Development Division (CRDD) are currently the official documents of the intended mathematics curriculum.

[2] Implementation purported to increase access, increase relevance, diversify education and reduce the duration of pre-university education. Prior to 1987, pre-university education in Ghana comprised 17 years; six years of primary school, four years of middle school, five years of secondary education and two years of a sixth form of education. Today pre-university takes 12 years and follows a 6-3-3 structure; six years of primary, three years of Junior Secondary, and three years of Senior Secondary school (MOE, 1988; 1996, Adjepong, 1996).

Today in Ghana, all Basic Schools (i.e., the first nine years of formal schooling) follow the nationally prescribed teaching programs contained in the school syllabus commonly referred to as the 'mathematics curriculum.' The mathematics syllabus is a statutory document providing policy directives for the overall goals of quality mathematics education. It gives a detailed prescription of what is to be taught at each level and it is framed within a behaviourist model emphasizing observable and measurable outcomes. The content of the primary mathematics syllabus (ages 6-11) covers six strands: (1) Number, (2) Shape and Space, (3) Measurement. (4) Collecting and Handling Data, (5) Problem Solving and, (6) Investigations (Ministry of Education [MOE], 1997; 2001). This curriculum frame is based on the recognition that "there simply cannot be any meaningful development in virtually any area of life without knowledge in Science and Mathematics" (MOE, 2001, p. ii).

While the curriculum is designed to focus on the development and use of basic mathematical knowledge and skills, the Curriculum and Research Development Division (CRDD) of the Ghana Education Service (G.E.S) also incorporated the philosophical goal to emphasize "indigenous mathematics" to increase its relevance for Ghanaian children (Pecku, 1998, p. 38).

These reforms define a changing role for the teacher as the curriculum states that "the general objectives can be effectively achieved when teachers create learning situations and provide opportunities that enable pupils to acquire as much knowledge and understanding as possible through their own activities" (Ministry of Education [MOE], 1997, p. 5). The role that the teacher plays in effectively implementing the objectives is highlighted throughout the curriculum. Parallel to reforms in mathematics education,

teacher education also underwent dramatic transformations. A brief history of those changes is provided in the next section to provide a context for education in Ghana.

## A Brief History of Teacher Education: The Ghanaian Context

Formal teacher education in Ghana has its roots from the Basel missionaries who established teacher-catechist theological seminaries in 1863. Their goal was to train people to educate the mulatto children and to develop a cadre of human resources of teacher-catechists to enhance their aims of evangelization on the coast. Essentially, the Basel missionaries established a four-year structure for a post middle school teacher education program: three years for a combined academic and teacher education program and one year training as a catechist. The requirement for entrance was a middle school leaving certificate. This set the pattern of teacher education in Ghana (Pecku, 1998). The Government established the first formal Teacher Training College in Accra in 1909 to supplement the Missionaries efforts. The duration of the teacher training course in Accra was two years (Bame, 1991).

Teacher education in Ghana has gone through different transformations under civilian and military regimes. In 1920 Gordon Guggisburg, then Governor of Ghana (formally known as the Gold Coast), set up a committee to examine how education could be improved. The committee recommended, among other things, the improvement of the quantity and quality of teachers. Their recommendations served as the basis of Guggisburg's sixteen principles of education of which the sixth principle stated "The staff of teachers must be of highest possible quality" (Pecku, 1998, p. 16). This recommendation was immediately implemented by instituting a 'register for teachers' as

a move to ensure that only qualified teachers could teach. Also, the duration of teacher training was increased from two to three years and later to four years in 1927 (Bame, 1991; Pecku, 1998). However, the training of women teachers continued in two-year teacher training colleges.

In 1937, a committee appointed by the Board of Education recommended two different courses and types of teaching certificates, a two-year course for infant junior school and a four-year course for senior primary schools. (Infant junior schools were for ages 6-11 and senior primary schools were for ages 12-15.) On successful completion of their courses the teachers were to be awarded certificate "B" to teach in the infant junior program and certificate "A" to teach in the senior primary program. This was the origin of the two types of certificates in teacher education in Ghana.

In 1951, the nationalist government of Convention People's Party (CPP) enacted the Accelerated Development Plan (ADP) for Education. This empowered the Ministry of Education (MOE) to take control of the quality of education in Ghana. During this time, the ADP with its universal primary school policy saw a rapid expansion in primary education. While reinforcing the dual route, Certificate 'A' and 'B', they promoted the two-year certificate 'B' program in order to produce teachers faster. At that time each Teacher Training College also set its own standards for teacher training and teacher assessment. However, it was recognized that many assessments were improperly implemented leading to poor quality of teachers (Pecku, 1998).

In 1958, the National Teachers' Training Council (NTTC) of Ghana was established and charged with the responsibility of coordinating all forms of teacher-training to ensure and maintain quality (McWilliam & Kwamena-Poh, 1975; Pecku,

1998). The two-year teacher training program was abolished in 1962 because two years was considered inadequate for effective training of teachers.

In 1967, the National Liberation Movement (NLM) took power from the CPP and set up an Education Review Committee for reform. The committee recommended among other things that Certificate "A" be the "basic qualification" for teaching in primary and middle schools (Pecku, 1998, p. 35). (Certificate "A" is the certificate obtained after a four year post middle school teacher training program or three-year post secondary school teacher training.)

In 1972 the Progress Party (PP) Government assumed power and accepted the Education Review Committee's recommendations. They made the General Certificate of Examination Ordinary Level (G.C.E. O Level), a certificate acquired after secondary education, the requirement for entrance into Basic Teacher Education (Pecku, 1998). The secondary school certificate (G.C.E. O Level) has since remained the entrance requirement for Teacher Training Colleges (TTCs) in Ghana. Today middle schools no longer exist in Ghana, and after completing any initial teacher training program a person will receive a Post-Secondary Certificate "A" which entitles him or her to teach at the Basic School level. Basic School Education (BSE) covers the first nine years of formal schooling. The first six-years of BSE, known as primary education, cover Basic Stage 1-6 (BS1-6). The remaining three years of BSE cover the Junior Secondary School education (JSS1- JSS3). Schools established for these programs are collectively called "Basic Schools."

Significant changes to improve the quality of teacher education coincided with reforms in the mathematics education curriculum. These changes open possibilities for

teachers to acknowledge and value cultural knowledge that has always existed within Ghanaian communities. However, my recent interactions with student teachers in Ghana made me wonder whether the marginalization of the child's space in the primary school classroom has changed since I attended school.

## Games: An Opportunity for Curriculum Relevance and Indigenous Mathematics

An area of particular interest to me is the use of games, particularly cultural games, in the teaching and learning of mathematics. The mathematics syllabus for primary schools allows for the possibility of using games by asserting that for the study of relationships "games and puzzles" are to be used and concepts developed and established through practical activities (MOE, 1997, p. 5). Although a seemingly minor inclusion, I saw this phrase as having significant potential for reforming experiences in the mathematics classroom. While very little direction is given regarding the intention of the games or even the types of games appropriate, my understanding of the curriculum is that the inclusion was purposeful and that games were viewed as a means to promote indigenous mathematics through cultural games played in local communities.

Children in every Ghanaian community play cultural games. Many of these games involve significant mathematical content. As children observe, interact with each other and physically participate in the games, they are gradually inducted into the cultural mathematical heritage. Children learn mathematics relevant to their everyday activities. Much of this content bears direct relationship to the primary mathematics curriculum.

I believe that most children are familiar with cultural games and can learn mathematics through such games. The knowledge children acquire while playing these

games could serve as a foundation for their mathematical development. I also believe that the use of games may play an important role in linking home and school.

Although the Ghana mathematics syllabus categorizes what to teach at each level, the national mathematics curriculum neither identifies specific games nor suggests ways they could be used in the mathematics classroom. While I see games as an opportunity to meet the philosophical goal of incorporating indigenous mathematics and increasing relevance for children, I wondered if primary schoolteachers made the same connection between indigenous mathematics and cultural games that I did. In fact, I wondered whether they were incorporating the use of games in the mathematics classroom at all. Did the explicit inclusion of games in the curriculum mean that teachers were actually using them?

While teacher education in Ghana has been improved significantly, Kadingdi (2001) laments the existing gap between curriculum reforms and teachers' mathematics practices. The Mathematics Syllabus for Training Colleges states that, "[t]he approach to the learning/teaching of mathematics should be based upon the understanding of mathematical concepts and their application to real-life situations. ... The teaching of maths in school should include experiments, outdoor activities, games, and investigations" (Ministry of Education [MOE], 1992, p. 1). The use of games in the mathematics classroom is also supported somewhat with teaching resources that include globally well known games (e.g., dominoes, bingo); however, teaching resources are not available that feature cultural games specific to communities in Ghana. For teachers to use these cultural games in their mathematics classes, they need to recognize their value

and purposefully identify and incorporate cultural games that are relevant to their community and that are related to the mathematics curriculum.

It is against this backdrop of the existing discrepancies between curricular prescriptions and curricula realities that this study was undertaken to examine primary teachers' experiences and perspectives of using common and cultural games in the mathematics classroom in Ghana.

## Research Question and Objectives of the Study

I come to this research with a particular bias that cultural games have the potential to promote indigenous mathematics, aid curriculum relevance, and help children cross the divide separating school mathematics and cultural knowledge. However, my research questions are more broadly focused. The inclusion of games in the curriculum is but a small part of mathematics education reforms encouraging teachers to create environments where children learn through practical activities. I believe that the classroom teacher in Ghana plays a vital role in implementing reforms, but I was uncertain whether teachers were even including games in the mathematics classroom, let alone acknowledging the potential that cultural games may have in providing culturally relevant experiences for children. Consequently, my main research question is simply: *What are the experiences and perspectives of primary school teachers in the use of common and cultural games in the mathematics classroom?*

My main objectives are to explore primary school teachers':

- past experiences with cultural games in their own communities, education, and practice;

- perspectives on the purposes, advantages and disadvantages of using games, both common and cultural, in the mathematics classroom; and
- awareness and knowledge of cultural games for mathematics teaching and learning.

Using a large-scale survey and interviews with selected participants (described in Chapter III), I embarked on a study that would contribute to understanding the teacher's use and non-use of games in primary schools.

## Definition of Terms

The literature review in Chapter II will provide depth to concepts used in this study. For clarity, the terms *experience*, *perspective*, *game*, *cultural games*, and *common games* are briefly defined here to highlight key terms used in the study and to situate further discussion of them.

### *Experience*

The term *experience* refers to the knowledge resulting from observation or practical knowledge, or from what one has undergone (OED, 2007). Experience involves ongoing interactions in a social, cultural and physical world. Experiences form a continuous and interactive force that arouse curiosity, strengthen initiative, and move the individual to act (Dewey, 1938). A person's experiences build on and often alter ways of knowing and personal perspectives. Experiences make it possible for the individual to develop a frame of reference for pedagogical reasoning and actions.

### *Perspectives*

A teacher's *perspectives* are his or her reflective interpretations of experiences that inform and serve as a basis for pedagogical decisions and actions (Pajares, 1992). In the implementation of a new curriculum, teachers' perspectives of the curriculum materials are essentially their reflective evaluations of the pedagogical significance of the materials. Teacher perspectives in this study embrace the idea that teachers' thinking and actions are inseparable in the art of teaching. In this regard, teachers' perspectives include their values, knowledge, and their affective attributes that influence their actions and decisions to accept or reject certain norms for practice. As teachers differ in their experiences, their perspectives about the curriculum intent of games as a means to make mathematics accessible to children may also differ.

### *Game*

The primary school mathematics syllabus mandates games to be incorporated in teaching mathematics (MOE, 1997); yet no definition of *game* is provided and no sample games are given. As a noun, g*ame* has a myriad of meanings. It is a "delightfully all-embracing" term that covers diverse activities (Davis & Pettitt, 1994, p. 82). Gordon (1970) describes a game as any "simulated contest (play) among adversaries (players) operating under constraints (rules) for an objective (winning)" (p. 8). Booth (1986) takes a broader perspective and suggests that games are a subset of play that binds the mind and body together and are based on the need to develop the whole person–body, intellect,

and emotion. I entered this study with a broad conception of game as a subset of play to be inclusive of all participant perspectives.

### *Cultural games*

In this study, I use the term *cultural games* broadly to refer to those contests or playful activities shared by the members of the community over several generations. In Ghana, there are many cultural groups and cultural games. Some cultural games are specific to particular cultures and others cut across different cultures. Cultural games as situated activities are visibly played for pleasure but potentially involve significant mathematics learning. In this study, cultural games will be used to mean organized playful activities rooted in the cultural life of a cultural group over generations. Throughout the thesis I try to use the phrase "cultural games" purposefully and consistently; however, the term "traditional games" was used extensively in the data collection and appears occasionally in the text when referring to the questionnaire and participant comments. "Traditional" should be considered here to be synonymous with "cultural games."

### *Common games*

A *common game* is defined here as a universal game, familiar to people across communities, countries and even continents. It is a game that finds its way to a cultural group by diffusion and has undergone no evolution to reflect the cultural life of the community. That is, it is named and played the same regardless of where the playing occurs. Games such as dominoes, bingo, and snakes and ladders are considered here to

be common games that come to Ghana by cultural diffusion and do not reflect the cultural heritage of the communities.

## Significance of the Study

I embarked on this study to initiate research on teachers' experiences and perspectives of the use of games in the mathematics classroom. No study to date has examined Ghanaian teachers' instructional perspectives of using common or cultural games in mathematics. Consequently, this search to understand and describe Ghanaian teachers' experiences with games will contribute to understanding the possibilities and challenges of using games in the mathematics classroom. On a smaller scale, it also examines efforts of teachers to enact a culturally relevant curriculum through the use of cultural games.

Teachers' experiences and perspectives influence decisions about using games in the classroom. If games are to be used, then there is a need to establish guidelines for their usage, otherwise the primary "curriculum can degenerate into a situation of fun and play" (Smith, 1997, p. 7). Similarly, if indigenous mathematical ideas are to be used in mathematics teaching, "we must know about the indigenous mathematics so that we can build effective bridges to the new mathematics we are trying to introduce" (Gay & Cole, 1967, p. 1).

My research on teachers' perspectives on game use in mathematics is a way of capturing the current curriculum recommendations. Such insights about teaching practices regarding games will enrich not only my understandings but also those of classroom teachers and policy makers. The exploration of Ghanaian teachers'

experiences and perspectives using games, in effect, is an evaluation of the innovative proposal of the use of games in the curriculum. It provides knowledge about how some primary school teachers utilize games in the classroom and unearths their concerns about the use of games to inform policy decisions.

## Outline of Study

This study, designed to explore primary teachers' experiences and perspectives on the use of common and cultural games, is structured within six chapters. In Chapter I, I presented the background of the study leading to the research question and the justification of the study. Chapter II, I examine craft knowledge as a conceptual framework for my study. In particular, I examine the varying descriptions of craft knowledge, the role of craft knowledge in curriculum change, and the sources of craft knowledge. In Chapter III, the methodology chapter, I discuss the research design, the research context and participants, data sources and data collection procedures, and data analysis. In addition, I examine the limitations and delimitations of the study, the ethical issues, and my role as a researcher in the research project. In Chapter IV, I examine, interpret, and discuss the data from the questionnaire. Looking at interviews with teachers in Chapter V, I interpret and discuss teachers' experiences and perspectives of the advantages and disadvantages of using common and cultural games in teaching mathematics. In Chapter VI, the three sources of craft knowledge described in Chapter II are revisited in the context of using games and the findings, recommendations and implications discussed in relation these sources.

# CHAPTER II

# CONCEPTUAL FRAMEWORK

In chapter one, I presented the history of reforms in curriculum and teacher education along with a background of games in the curriculum that led to my research questions. In this chapter, I examine craft knowledge as a conceptual framework for my study. Craft knowledge was selected because it provides a broad view of teacher knowledge that can incorporate teachers' experiences and perspectives in using common and cultural games to teach mathematics. In particular, I examine the varying descriptions of craft knowledge and the role of craft knowledge in curriculum change. Since the core of the study is on the use of games, I then examine the literature on the use of games in the classroom and give examples of cultural games I encountered during the study.

## Craft Knowledge

The educational curriculum reform of 1987 in Ghana introduced games in the mathematics curriculum to diversify learning and introduce practical skills in mathematics. The education reform does not only demand teachers to be broad-based in their content knowledge but also change their practice. In this study, I focused on teachers' experiences with and perspectives about the use or non-use of games in the mathematics classroom. Through the data collection (described in Chapter 3), I attempted to make their craft knowledge "visible."

Traditionally, 'knowledge' is viewed as a product of research, rather than practice. This knowledge is then applied to problems of practice in a discipline. However, as Schön (1983) proposed, practice in and of itself is a valued form of knowledge. Much of teaching can be viewed as knowing how to act in the moment or as "knowing-in-action". While the actions are observable and explicit, the knowing underlying the actions is often implicit or invisible. Professionals, including doctors, lawyers, architects and teachers, are highly dependent on this type of knowing, or craft knowledge, as they engage in practice.

The term 'craft' applied to pedagogy originated in America and Britain in the 1970s. Scholars such as Lortie, Cohen, McNamara and Desforges questioned the appropriateness of social scientific knowledge as the basis for understanding classroom practice (Cooper & McIntyre, 1996). These scholars suggested teaching was a craft and that understanding teaching, required accessing teachers' craft knowledge implicit in their activities and decision making.

Craft knowledge refers to the practical aspects of teaching. It has been defined as "wisdom of practice" (Shulman, 1987, p. 11), "contextualized knowledge" (Leinhardt, 1990), "occupational savvy" (Grimmett & McKinnon, 1992), "practical knowledge" (Elbaz, 1983) and "personal practical knowledge" (Connelly & Clandinin, 1988). The common link for these conceptions of teachers' knowledge is the recognition that during practice, teachers develop a type of knowledge that is different from research-based knowledge. Craft knowledge has long been undervalued and ignored. It is an integrated set of a teacher's implicit theories, expertise, propositions, and tacit knowledge applied

to daily practice and derived through experience. From the craft perspective, knowledge of teaching is derived primarily from teachers' practice in context.

> Thus, craft knowledge of teaching is not substantive, subject matter knowledge, nor is it syntactical knowledge (that knowledge that derives from the disciplines and enables people to know how to acquire further disciplinary knowledge); rather, it is a particular form of morally appropriate intelligent and sensible know-how that is constructed by teachers, holding progressive and radical educational beliefs, in the context of their lived experiences and work around issues of context-related and learner focused pedagogy. (Grimmett & MacKinnon, 1992, p. 396)

Craft knowledge, in contrast with other forms of knowledge, is the knowledge that experienced teachers acquire during their classroom practice to enable them to engage students effectively in the learning process (Cooper & McIntyre, 1996). As the knowing-in-action developed by teachers in the course of teaching (Brown & McIntyre, 1993), it describes teachers' experiences and learnings (Barth, 2001) and examines the art of teaching in relation to the ways in which implicit theories of teaching are enacted practically (McAllister & Rowe, 2003). Craft knowledge captures what teachers do unconsciously in their day-to-day classroom teaching; it influences the ways in which teachers structure and organize time and space to foster learning. The craft of teaching is an occupational technique integrated into practice to account for teachers' everyday practice.

In recent times, there has been an increasing awareness that practitioners in teaching know a great deal more about the complex processes of teaching of "bringing

the inside out" and "putting the external back inside" than social science research theories account for (Shulman, 2000). In these complex processes of teaching, craft knowledge tends to be an "inch wide but a mile deep." In contrast, social science research knowledge tends to be "a mile wide but an inch deep" (Barth, 2001, p. 56). Hiebert, Gallimore, and Stigler (2002) summarize the benefits of craft knowledge into three categories: it is directly linked with practice, it is detailed, concrete and specific, and it is integrated. In contrast, research-based knowledge is abstract, and requires translation which teachers find difficult. The educational reform in Ghana gives due recognition to concrete practical activities integrated in all aspects of learning mathematics (MOE, 1997), and through craft knowledge primary teachers in Ghana can develop a mathematical classroom culture that provides opportunities for learning.

Like other professionals, the discourse of craft knowledge helps teachers share their practice and work towards developing a body of knowledge around their practice. Craft knowledge and research-based knowledge complement each other and contribute to teaching to maximize the breadth and depth of instruction to make mathematics learning meaningful to learners. Instead of separating "research knowledge" from "craft knowledge" in teaching, they need to be integrated and viewed as valid forms of knowing. Although the recognition of craft knowledge can transform educational practice, "[o]nly by recognizing and using both sources of knowledge can educators truly transform our schools and turn teaching into a true profession" (Burney's, 2004, p. 526).

## Content of Craft Knowledge Base

Teachers' craft knowledge (from the cognitive perspective) is developed through professional actions in experimenting and solving problems in the course of teaching (Burney, 2004). Although the teachers' craft knowledge is essentially implicit, its content can be identified by its purposes in the practice of teaching. Leinhardt (1990) likened the craft knowledge metaphor to master-apprenticeship relations. It is then reasonable to expect the master to pass on to the apprentice a corpus of knowledge. Grimmett and McKinnon (1992) described the ultimate purposes of craft knowledge of teaching as "understand[ing] and engag[ing] the minds of learners" and "becoming an advocate for all students and their learning". In these roles, craft knowledge "emphasizes judgment", relies on "intuition, care, empathy, search for meaningful schooling and benefits for pupils." It includes seeking to know students, listening and reaching out to them with care and understanding, fostering learning, curiosity about events, encounters, and experiences. It seeks to "transform classrooms", "encourage collaboration" and to make learning memorable (p. 429). From cumulative experiences, teachers know and use extensive knowledge in their teaching.

Given the origin of craft knowledge, its content may consist of "hard-won insights garnered by teachers" about important educational matters (Barth, 2001, p. 56), or an aggregation of both the "kernels of knowledge" and the "chaff of superstition" (Leinhardt, 1990, p. 23). Any experienced teacher in the classroom possesses craft knowledge in areas relevant to the improvement of education such as teacher roles, curriculum development and discipline knowledge. Their experiences as practitioners predispose them to implicitly knowing, for example, what to teach and how to teach

different grades, how to promote interactions, how to motivate children, and how to assess understanding, in ways other than what is typically codified by research.

## Concerns about Teachers' Craft Knowledge as a Knowledge Base for Teaching

Although craft knowledge consists of important and insightful information about potentially best practices, including curriculum implementation, some researchers are skeptical of using it as a knowledge base for teaching. The traditional craft paradigm is concerned with the mastery of content knowledge and the technical skill of teaching learned through imitation or trial and error. However, a progressive paradigm reveals craft knowledge as an active process of inquiry for novice teachers to learn from 'experts' by observing, doing, and interacting with their implicit theories, experience and understanding of the content (Grimmett & McKinnon, 1992). Leinhardt (1990) describes craft knowledge as experienced teachers 'wisdom of practice' that includes "deep, sensitive, location-specific knowledge of teaching, and also includes fragmentary, superstitious and often inaccurate opinions" (p. 18).

Barth (2001) and Hiebert, Gallimore, and Stigler (2002) draw attention to the problems with the personal nature of the craft knowledge of teaching. While there are inherent difficulties in "distinguishing the gold from the gravel" (Barth, 2001, p. 57), there are also concerns about what and whose knowledge to explicate, how to access the knowledge, and how to ascertain its veracity (Hiebert, Gallimore, & Stigler, 2002; Leinhardt, 1990). Burney (2004), Barth (2001) and McAllister and Rowe (2003) all noted teachers' craft knowledge is "mute" or hidden in the dark and suffering from isolation. In teaching, "autonomy and creativity [is regarded] ... as the badge of

professionalism" (Burney, 2004, p. 528). Notions that one's knowledge, skills, and success are gold nuggets best stored in privacy (Barth, 2001) make craft knowledge largely inaccessible to others for verification. Teachers tend to work in isolation and refrain from sharing successes and failures with others. The result is unexamined and untested knowledge that potentially affects the quality and effectiveness of curriculum implementation.

Although craft knowledge is largely implicit, Brown and McIntyre (1993) state that the characteristic differentiating a novice from a craftsperson is the ability to analyze a teaching situation. Novice teachers tend to hold literal views about objects and situations, while experienced teachers make inferences about objects and situations. Berliner (1986) also pointed out that experienced mathematics teachers assume expert status based on their ability to integrate domains of knowledge in the practice of teaching.

Craft knowledge researchers (Brown & McIntyre, 1993; Cooper & McIntyre, 1996; Duffee & Aikenhead, 1992; Lantz & Kass, 1987; Leinhardt, 1990; Van Driel, Verloop, Van Werven, & Dekkers, 1997) have demonstrated that access to teachers' craft knowledge is possible through teacher talk. Barth (2001) identified "teachers teaching teachers" and "telling stories" as important ways of recognizing and sharing such knowledge. Hiebert, Gallimore, and Stigler (2002) and Ruthven (2002) explained that there are reversible processes for transforming teachers' craft knowledge into research-based knowledge. By subjecting craft knowledge to the ethics of research—that is, by examining and verifying it publicly—it is refined and improved to qualify for research-based knowledge (Hiebert, Gallimore, & Stigler, 2002). Similarly, Ruthven

(2002) illustrates craft knowledge and research-based knowledge as constituting a dialogic relationship in teaching. Research-based knowledge "(re)contextualized and activated within teaching" stimulates the "(re)construction of craft knowledge" whereas craft knowledge "elicited and codified" in the process of research stimulates the "(re)construction of scholarly knowledge" (p. 595)

From the above discussions and definitions, craft knowledge is the practical meanings teachers ascribe to their practices in the act of teaching. It is experiential and relies on the teacher's intuition for the purpose of making learning meaningful. Craft knowledge builds on thought and actions from practice rather than from external sources. Teachers' craft knowledge is therefore assumed to be diverse, but particularistic and context-specific. Consequently, it accounts for the purposes of classroom practices in context and stimulates teachers to reflect on why they do certain classroom practices and reject others in curriculum implementation. Since teachers' experiences and intuitions vary, so does their craft knowledge base of teaching. In curriculum implementation, it is the teachers themselves who have first-hand knowledge from their distinct perspectives of what they do and why in their respective classrooms. It is therefore valuable to consider teachers' craft knowledge as the basis for examining teachers' perspectives on curriculum change and implementation of those changes.

## Craft Knowledge and Curriculum Implementation

The 1987 reform in mathematics education in Ghana is based on a philosophical orientation of teaching and learning mathematics that emphasizes understanding, application, active engagement, connections, relevance, and depth of coverage. The

curriculum materials guide the curriculum implementation pathways. Games as instructional materials within the reform act as tools for instructional improvement and curriculum relevance. The use of games in curriculum implementation depends on the teachers' craft knowledge.

Craft knowledge and curriculum implementation has a limited research base compared to other forms of knowledge particularly in mathematics education. However, studies have examined teaching to uncover and understand teachers' craft knowledge in curriculum implementation in other areas. Brown and McIntyre's (1993) work examines how teachers make sense of their knowledge and thought in the classroom. In their study, teachers took contextual factors, such as demands, pressures, time, and materials among others, as central to their thinking and decision making in classroom practice. Teachers' craft knowledge was seen to be influenced by the activity, progress, and conditions that provide the basis for interpreting teachers' sense making process. Similarly, Cooper and McIntyre (1996) noted that teachers' judgments about what to do is based on the (a) *aims* and professional commitments (e.g. syllabus coverage) (b) *objectives* (i.e. outcomes and progress, time consideration); (c) *performance* (i.e. how skills are presented and their appropriateness for success); and (d) *image* of the type of classroom sought. Furthermore, teachers' craft practice is informed by cognitive, affective, and social considerations. Brown and McIntyre (1993) and Cooper and McIntyre (1996) studies demonstrated that teachers draw on a vast array of knowledge in making pedagogical decisions to make the curriculum accessible to learners. Although Cooper and McIntyre's study was structured on the early work of Brown and McIntyre (1993), the

differences in judgments and practices suggest the complexity of craft knowledge and the various ways it can influence the process of curriculum implementation.

Duffee and Aikenhead (1992), Lantz and Kass (1987) and Van Driel, Verloop, Van Werven, and Dekkers (1997) focused on the relationship between teachers' craft knowledge and the ways they perceive and interpret curriculum change. Although their focus was somewhat different, these studies reveal that teachers' craft knowledge influences the implementation of curriculum innovations. Teachers' interpretations of their practices in a new curriculum are a reflection of their personal understandings deeply rooted in their beliefs and values. While they interpret and adapt the innovations in ways that make sense to them (Duffee & Aikenhead, 1992; Shulman, 1987), they also select and adapt methods and teaching materials that suit their students and take actions based on conditions that worked (Ball & Cohen, 1996; Cooper & McIntyre, 1996). The mode of selection and adoption may create a gap between curriculum intentions for students and what is enacted. Other factors that may influence the selection and adoption of materials, as identified by Ball and Cohen (1996), include concerns about students and their prior experiences, teachers own understanding that shapes their interpretations, the nature of the materials and the tasks, the intellectual and social environment, and the community and policy framework.

Compared to research on teaching, little research has examined teachers' use of curriculum materials as mechanisms for implementing change. Recent analyses of curriculum materials provide rich insights into the relationships between the materials themselves and mathematics teaching (Collopy, 2003; Remillard, 2000; Remillard & Bryans, 2004). These studies focused on how teachers interpret and interact with

curriculum materials in their teaching. Teachers' knowledge and beliefs continue to shape their interpretations and uses of curricular materials. Their beliefs and values serve as a filter through which they interpret the curriculum. Of particular interest is the enactment of the materials which is shaped by the teachers' orientations—"a set of perspectives and dispositions about mathematics"—that influence how teachers engage and interact with curriculum materials in classroom practice (Remillard & Bryans, 2004, p. 364). Enacting the curriculum through the materials requires the teacher to make on-the-spot decisions about what to select and how to adapt them in response to classroom events. Similarly, Grant, Peterson, and Shojgreen-Downer (1996) observed that teachers use manipulative and concrete objects in activities they believe will actively engage students and help them develop and understand mathematical concepts.

Judgments in the choice and adaptation of relevant materials are critical in curriculum implementation. Lappan (1997) argues

> No decision that teachers make has a greater impact on students' opportunity to learn and on their perception about what mathematics is than the selection, adaptation, or creation of the tasks with which the teacher engages the students in studying mathematics. … To make selections from tasks in curriculum materials, or to adapt or craft tasks that give students deeper, more relevant opportunities to actively engage with mathematics, the teacher must be mindful of both the mathematical potential of the task and the student for whom the task is intended. (p. 213)

Central to teachers' decisions and judgment about implementing mathematical innovations is the need to reflect on worthwhile tasks, discourse patterns, the

environment, and analysis of teaching. Lappan's domains of reflection take into consideration background experiences, mathematical value of the materials, learners' feelings, context, interactions, how to represent ideas, the environment, and expectations. However, although the emphasis on curriculum materials in reforms is typically on the representation of mathematics content, Ball and Cohen (1996) noted that curriculum developers' pedagogical judgments for representations might remain hidden from teachers as they adapt, omit, or augment the materials. They argue that if the gap between materials and teachers' knowledge is wide and teachers remain isolated, they may either use them differently than intended or may choose not to use them at all. From a craft knowledge perspective, teachers' judgments, interpretations of and actions on curriculum materials establish links between curriculum intentions and the use of curriculum materials in curriculum implementation. Teacher decisions and judgments are thus important components of craft knowledge in curriculum implementation.

Lantz and Kass's (1987) interpretive study of teachers' functional paradigms provide a useful start for thinking about teachers' experiences in curriculum change. In their study, teachers' response to curriculum innovations is heavily dependent on the teachers' experiences and their current teaching situation. Their interpretation of curriculum innovation is influenced by elements of their functional paradigms, background experiences, and the teaching situation. Lantz and Kass posit that teachers' functional paradigm, constituting their set of beliefs and values, determines how curriculum is translated into classroom practice. This assertion was based on the assumption that teachers' interpretation of curriculum innovation bears a direct relationship with curriculum intentions and curriculum implementation.

Building on Lantz and Kass's (1987) functional paradigm, Duffee and Aikenhead (1992) examined the relationship between craft knowledge and curriculum change. They presented a heuristic model for curriculum change that adds a new dimension to the factors that influence the teacher's craft knowledge. Their model suggests teachers' craft knowledge in curriculum change is a "holistic, interactive, and organic set of ideas" (p. 497) made up three major sources: (a) the **teachers' past experiences**—including life, education and teaching experiences which forms an "encyclopedia of personal knowledge" (p. 495); (b) the **current teaching situation**—involving instructional decisions based on practical principles or rules of practice for specific situation, and understandings of current teaching situation based on the pedagogical content knowledge, and classroom conditions and environment; and (c) the **teachers' vision** of how teaching should really be—involving images of what teaching should be like based on the teachers contextualized knowledge. A teacher's visions of practice provide that basis for decisions on curriculum implementation. In this study, these three sources were used extensively to frame the analysis, interpretation and discussion of teachers' experiences and perspectives regarding the use of common and cultural games in the mathematics classroom.

### *Past experiences: community, school and teaching*

Although experience as a process of knowing has a traditional empiricist origin, its use here is within a constructivist paradigm. Mathematics educators and researchers have recognized the importance of experience as an educational resource in making connections and shaping pedagogical actions. Teachers' understanding develops from

their personal experiences and their interpretations of their experiences in different settings (Duffee & Aikenhead, 1992). These experiences are a rich source of knowledge for developing the art of teaching. Barth (2001) argues that,

> our educational institutions must recognize the importance and power of learning that emanates from the rich range of daily experiences that students have. [It is] only when we succeed in relating the curriculum to what is relevant in youngsters experiences will we begin to 'teach' them. [These experiences constitute a] unique, deep, thick ethnography [and] a treasure trove of knowledge for the practitioners, the profession, and for the school. (p. 55)

Teachers respond to curriculum innovations by reflecting on their domains of experiences in life, education, and practice. Building on experience is based on the theoretical view that development and learning is a constructive process in which the learner builds on existing schemes brought to the learning situation.

A teacher's experiences shape his or her understandings for practice. Different circumstances bring forth different experiences to bear on a teaching situation. Consequently teachers' reflect on their unique experiences to respond to the "what", the "how" and, the "why" of a lesson in a particular context (Rigano & Ritchie, 1999, p. 136). The "what" focuses on important activities and content of the lesson, the "how" explicates the implicit knowledge about criteria for selecting activities and content and, the "why" draws on the reasoning behind the activity and content chosen.

Teachers' reflections allow access to their values and beliefs that guide their practice (Rigano & Ritchie, 1999). As teachers' range of experiences is vast, reflections on their background experiences are not only a reconstruction of the past but also a

reconstruction of intentions for the future to deal with the exigencies of the present (Connelly & Clandinin, 1988). These background experiences are integrated with their teaching experiences and have profound influence on their interpretation and adoption of curriculum materials.

A precondition for generating craft knowledge for curriculum implementation is reflecting on experiences and finding pedagogical meaning in them. Barth (2001) states that "[i]t is through reflection that we distil, clarify, and articulate our craft knowledge" for practice (p. 65). Reflection on experience "contributes to the refinement of subsequent action and to the building of a repertoire of professional craft knowledge" required to build a hospitable environment for curriculum implementation (p. 74). He argues that momentary reflections in practice will enable the teacher to later "reflect more contemplatively on practice" (p. 67). Reflection on practice stresses the idea that teachers learn by analyzing experience of situations that have occurred with a focus on improvement. In contrast, reflection in practice stresses the idea that teachers engage in reflective analysis about their experience to frame and re-frame their activities while they engaged in them to be successful. Similarly, Schön (1983) contends that "reflection on knowing-in-action" goes with a "reflection on the stuff at hand" (p. 50). Such reflections bounded by the "action-present" enable the teacher to develop coping mechanisms "to cope with the troublesome 'divergent' situations of practice" (p. 62).

Teachers draw on their experiences in their communities, education and practice to make connections to curriculum expectations and to shape pedagogical decisions. In this study, teachers' experiences in their communities and in schools are viewed as an

important source for shaping decisions made regarding the implementation of games into classroom practice.

### *Current teaching situation*

The current teaching situation informs the teacher of the relevant pedagogical decisions. Demands on any teaching situation impose restriction that require decision-taking. Decisions on the current teaching situation are filtered through the teachers' perspectives and practical principles of teaching. Opportunities to advance mathematics teaching are facilitated when teachers' perspectives are consistent with the curriculum goals.

A teacher's current situation influences his or her interpretation of curriculum materials and establishes the parameters within which the teacher operates. In translating the curriculum materials into practice, teachers are concerned with the teaching conditions that impinge on practice including the physical environment, community-school relationships, class size, student diversity, the nature and supply of materials, and the nature of class activities (Brown & McIntyre, 1993; Lantz & Kass, 1987; Lappan, 1997). Teachers respond to these conditions and act in ways demanded by their situations which lead to decisions regarding how or if curriculum materials are used to design activities for learning and translated into practice (Van Driel, Verloop, Van Werven, & Dekkers, 1997; Zeichner, Tabachnick, & Densmore, 1987).

Teachers teaching in different situations are challenged with different problems to address. Teachers in rural schools in Ghana tend to deal with fewer students, personnel and resources; their urban counterparts often have more students, but also more staff and

resources. Differences in demographic characteristics of the current teaching situation influence the teachers' decision-making and interpretation of the use of materials (Lantz & Kass, 1987). The curriculum materials available include teachers' guides, student textbooks, and teaching and learning aids provided in the current situation. In Ghana, Mereku (2000) examined the primary mathematics textbooks and teachers' classroom practices to ascertain the teaching methods presented in the official curriculum materials and teachers' instructional practices. He observed that the teachers' handbook stressed teaching strategies associated with expository teaching methods characterized by "whole-class teaching" organizational style and a unidirectional interactive mode from teacher to student. Teachers "infrequently use teaching and learning materials, practical and game activities" and the few who use them tend to use the materials which are conveniently within reach termed as "opportunity aids" (p. 21). The teachers' views and the educational structures of the current situation largely inform classroom practice. Teacher autonomy and isolation in pedagogical practice produce variation in "personalized forms of instruction ... [that] ... prevents the development of a professional knowledge base" for teachers to organize and to create standards for instruction (Burney, 2004, p. 828).

The current teaching context and educational structures in place have consequences for how reforms are understood and implemented. In this study, the current teaching situation is viewed as a primary source for the development of craft knowledge in the use of games in the mathematics classroom. Past experiences and current teaching conditions help shape a teacher's idealistic view of what is and what is not possible in the classroom; that is, his or vision of teaching.

*Vision of teaching*

Teachers' experiences and the current teaching situation precipitate into their vision of how teaching should be. A teacher's vision is "a kind of moral imagination" (Barth, 2001, p. 264) that gives the ability to see an instructional situation as it is and how it should be. Teaching as a multifaceted activity is driven by the teacher's vision. A clear vision depends on a strong purpose, direction, and momentum. It enables the teacher to 'see' what will happen and sequence selected content and activities that will lead students through the curriculum (Kennedy, 2006). Teachers' vision of curriculum materials depends on their perspectives informed by their experiences of how the materials can be used to improve or help children understand mathematics. Their visions are response image-mechanism pathways for curriculum implementation.

The vision of what the teaching situation should be is a reflection of the teacher's feelings, values, beliefs, experiences, theoretical knowledge and school life (Duffee & Aikenhead, 1992) or functional paradigms (Lantz & Kass, 1987) in relation to classroom practice. The vision provides a mental image for decisions and actions. "Image" (Cooper & McIntyre, 1996) or "vision" (Duffee and Aikenhead, 1992) is descriptive statements linking craft knowledge and practice. The combination of the teacher's feelings, values, needs, and beliefs form images of how teaching should be (Elbaz, 1983). The vision for pedagogical practice is informed by the teachers' experiences and the current situation of teaching.

Mathematics education in Ghana is created with a view that mathematics is a medium of communication and a problem solving device whose practices should be related to the child's environment and geared towards understanding fundamental

mathematical concepts. With this vision, pedagogical efficiency, academic rigor, and the motivation of students are important considerations towards adapting and using curriculum materials (Lantz & Kass, 1987). A measure of the pedagogical efficiency of a material is its ability to facilitate curriculum implementation and to provide students with a clear understanding of what they are to learn. Teachers then select curriculum materials based on the aims and objectives of the lesson and choose practices that they believe are best, important, and consistent with their values and vision of what the teaching situation should be (Cooper & McIntyre, 1996; Duffee & Aikenhead, 1992; Van Driel, Verloop, Van Werven, & Dekkers, 1997).

Prior to 1987 reform in Ghana, the mathematics education was based entirely on a transmission model of instruction. The new curriculum now encourages a more interactive approach involving active construction and exploration of knowledge. However, available resources, educational structures and other aspects of the current situation present a potential clash of visions that have implications for effective curriculum implementation. Teachers may choose to resolve the incongruencies between the vision presented in the curriculum and their own vision by making changes to their practice, by altering expectations in curriculum or by dismissing reforms as impracticable and inappropriate to the teaching and learning of mathematics.

A teacher's experiences, current teaching situation and his or her vision of teaching are the three sources used in this study to examine the development of craft knowledge in relation to games. Although a study of Ghanaian teachers' understanding and use of games in the mathematics classroom has not previously been undertaken, research on games, particularly in the mathematics classroom, has occurred. In the next

sections, I examine the literature on the use of games in the classroom and share examples of the common cultural games in Ghana to provide further context for understanding teachers' experiences and perspectives with games available in their communities.

## The Use of Games in the Classroom

Educators, notably Froebel and Montessori, who initiated and stressed the importance of games as a teaching tool, proposed that children can best learn by incorporating play methods into the teaching learning process (Freie, 1999). Such methods are not only good activities that pique students' curiosity and draw them into mathematics learning (National Council of Teachers of Mathematics [NCTM], 2000) but also "invoke multiple frames of reference" (Hughes, 1995, p. 108). Multiple frames provide avenues for meaning making in different ways. It is, therefore, valuable for classroom teachers to incorporate games in their mathematics lessons since "playing them is an important human activity that affords substantial opportunities to experience and explore mathematics within the context of culture" (Barta & Schaelling, 1998, p. 388).

The use of games in mathematics class is supported by several researchers and educators (Booker, 2004; Casbergue & Kieff, 1998; Gerdes, 2001; Hancock & Osterweil, 1996; Kamii with Housman, 2000; Markey, Power, & Booker, 2003) who believe in allowing children to make their personal mathematical constructions and to take responsibility for their own learning. Booker (2004) advocates the use of games for developing mathematical concepts as they lay "the foundations for processes and

thinking strategies that will be formalized later as well as consolidate existing thinking" (p. 16). They provide visual, auditory, and kinesthetic experiences for the construction of mathematical knowledge. In play children learn to think about strategies, to explore new interests by applying their experiences, to experience the fun of the game, to listen and cooperate with each other, and to learn by doing. In this role, games integrate the social, affective and cognitive aspects of learning (Booker, 2004; Ernest, 1986). Because games are governed by rules, the dynamics of applying the rules in play control the sociomoral development of the individual or groups (Booth, 1986; Fernie & DeVries 1990). Games therefore put the child in a web of learning opportunities that aid mathematical development provided the teacher recognizes this value and is clear with the circumstances under which such learning opportunities can be maximized.

It is a generally acceptable view that games serve as a bridge between formal and informal methods of learning and "provide an excellent way to teach math" (Charlesworth & Lind, 1999, p. 492). Games have built-in learning principles in their design (Gee, 2003). Researchers (Markey, Power, & Booker, 2003; Peters, 1998) and contemporary evidence demonstrates that games, indeed, teach mathematics depending on how they are organized. Their studies illustrate the power of games in providing alternative instruction strategies in which students interact with each other and with adults. Many authors (Booker, 2004; Markey, Power, & Booker, 2003; Swan & Marshall, 2005) have recognized the interactive aspects of games through which individuals construct knowledge, share knowledge and make meaning of the knowledge as critical behaviours in learning mathematics. In play, real mathematical issues arise and participants exchange ideas. Markey, Power, and Booker (2003) noted that "[b]ecause of

the interactions that occur between participants, games provide for discussion among students and between students and their teacher" (p. 253). Outlining the factors that can maximize learning opportunities with games, Swan and Marshall (2005) noted that the social context reinforces individual thinking, allows others to follow the reasoning pattern, and reduces the drudgery associated with learning alone. Although Gee (2003) recognized games as potential source of violence, he acknowledged their social learning principles in which children become producers rather than consumers of knowledge. The interactive pattern shapes the thinking process and one may think that the interactions help children link informal to formal mathematics. The acquired strategies in play promote and sustain children's interest and mathematical experiences.

The motivational value of games in learning and in active engagement is well documented (Booker, 2004; Ernest 1986; Markey, Power, & Booker, 2003; Kamii with Livingston, 1994). Through games, a child may develop the power of concentration and acquire a love of learning. Ernest (1986) notes: "Pupils become strongly motivated, they immerse themselves in the activity, and over a period of time should enhance their attitude towards the subject" (p. 2). The motivation generates excitement and involvement in mathematical activity. Shaftel, Pass and Schnabel's (2005) study shows that when a game is modelled to meet real situations and used continuously with tutoring and counselling, it can lead to positive attitudinal change through its motivational power. They, however, cautioned against their excessive use to maintain their motivational value. de la Cruz, Cage and Lian (2000) relied on the motivational power of games to change attitudes and used traditional games to help students with learning difficulties to succeed in mathematics. They argue that instead of looking for something new, we can

find effective alternative instructional strategies in traditional games. In both studies, games were viewed as catalysts for positive attitudinal changes.

Craft pedagogies relating to games as a curriculum innovation depend on curriculum objectives. Again, the ability of games to accommodate a wide range of developmental levels of children in the class is crucial (Kamii with Housman, 2000; Kamii & DeVries, 1980). Kamii with Housman (2000) suggest the use of a variety of games to break monotony. However, the personalities and the dynamics of each class are different. Importantly, there is no recipe that brings success to all children, so "the teacher has to experiment and judge how each group of children is thinking and feeling" (p. 207) in order to "select and encourage children to play those games which are likely to be of most value to any particular group" (Davis & Pettitt, 1994, p. 92).

The pioneering anthropological work of Zaslavsky's (1979) illustrates the mathematical richness of African cultural games. In contrast, Zaslavsky (1996) reports that in her study of a cultural network game among her ninth-grade social studies students, a student viewed the network activities as "pleasant recreation but could hardly be considered 'real math'" (p. 178). This may be attributed to what Gee (2003) termed as the problem of content arising from attitudes towards learning and knowledge that is deeply rooted in Western thought. Contemporary mathematics educators and researchers (Gerdes 2001; Powell & Temple, 2001), using cultural games, demonstrate that games provide opportunities for developing students' problem solving capacities and for exploring novel situations. Children can learn mathematical concepts and skills from cultural games. On the basis of these studies, the value of what is mathematical is likely to be shaped by one's personal disposition or by the curriculum lens.

The potential of games to provide opportunities for learning, motivation, curriculum relevance, and connections between formal school and informal indigenous knowledge discussed is apparent in the literature above. While an understanding of craft knowledge frames the analysis for this study, the literature above influenced my understanding of the purpose of games in community and classrooms as well as the potential advantages and disadvantages of games as a teaching strategy.

## Cultural Games in Ghana

During the study, participants shared examples of the games from their community, which allowed me to become familiar with some of the common types of cultural games in Ghana and the mathematics inherent within the games relevant to the primary school curriculum. Although these games were part of the data collection in the study, I describe five such games here in order to provide a context for the games discussed in subsequent chapters. The games described include a stone throwing game (*bisogi*), a pebble pushing game (*baa-baa*), a stone passing game (*kuriyee-kuriyee*), a pebble-sowing game (*daha*), and a jumping game (*ampe*). The descriptions below include quotations in italics from participants interviewed in this study.

### *Stone-throwing game, 'bisogi': an instructional tool for counting*

*Bisogi* is a stone-throwing game involving the use of white igneous stone pebbles of about 2 cm in diameter. A minimum number of seven stones are used. It is traditionally a girl game but boys can also play. One player plays at a time. Players learn to coordinate their visual and motor skills as well as practice their counting skills. The

rules vary according to the players and the number of stones used but generally, there are three basic rules: (1) the stone selected as the "*throwing stone*" should not fall to the ground at any time; (2) your fingers should not touch any stone on the ground other than the stones that are to be picked up; and (3) when a player fails a particular round, he or she has to start at the beginning of the game when it comes to his or her turn again. Below is a display of stones thrown on the ground for playing *bisogi.* The player has to reason and select the throwing stone from the display that will put him/her in an advantageous position with respect to the rules.

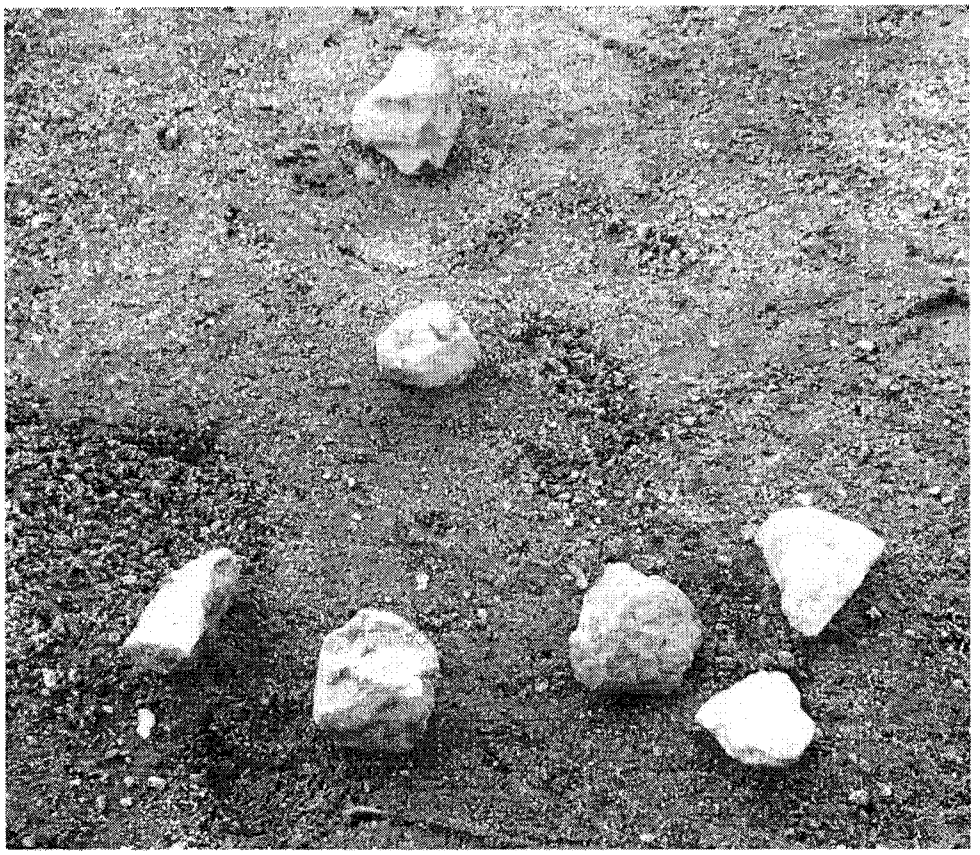


Fig.1: Picture of stones thrown for stone-throwing game, *bisogi*

To play this game, a player takes all seven stones and skillfully throws them on the ground. One stone is then selected as the "*throwing stone*" and used to pick up the others.

First, you throw the "*throwing stone*" in the air and pick up one stone on the ground while catching the throwing stone in the air. If you are successful you then throw the "*throwing stone*" in the air while trying to pick up two stones from the ground before you catch the throwing stone. You continue to add one more stone each time until all the stones on the ground are gone and the game is ended. It is a "*throw, pick and catch*" game as explained by Paul.

When playing with seven stones, a player has six rounds. If the stone falls to the ground it is a "*foul,*" meaning the player "*has lost and scores no point.*" A complete round is when the player successfully collects all the stones from the ground without violating any rules. If the player fails in a round, it is repeated when it comes to his or her turn again. The winner is the first player who successfully completes the six rounds.

The game provides opportunities for children to use and experience, counting, quantity comparisons and simple addition.

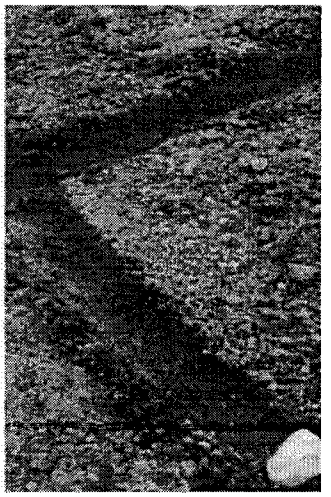
*Pebble-pushing game, baa-baa: an instructional tool for measurement*

*Baa-baa* is a traditional pebble-pushing group game played by both genders. Traditionally, the game is played on the sand after cleaning and smoothing it. Two or four people can play but a "*full game is four people*." If there are four players, a "*cross-like structure*" (+) is dug in the ground. The four lines define four paths of play: one for each player. Each line is about 15 centimetres long from the origin (i.e., where the lines intersect), a centimetre wide and 0.5 cm deep. For two players, either the two lines of the cross-like structure are covered leaving a right-angled structure or "*a v-shaped structure*"

of approximately $60^{o}$ is constructed with the same dimensions as described above. The two versions of the game are shown in figure 2.

A baobab seed is used as a "*playing seed*" because of its lightness and spherical shape that make it easy to roll on the ground upon the slightest push. Any small object with similar characteristics may be used as a substitute. To start the game, a player puts the "*playing seed*" at the end of his or her line and tries to push it into the path of the player to the right depending on the direction of play agreed upon. If the player succeeds, he or she measures the distance scored from the origin and extends his or her line by that margin. The playing seed remains at that position and the next player also tries to push it into the path of the player on his or her right. For each round a player has one chance to push the playing seed. Players continue in turns from wherever the playing seed lands. A player is eliminated when the "*head is cut*" (s(he) is overtaken). Once the game starts, the playing seed remains on the ground until the game ends when a player succeeds in eliminating all other players.

(a) Game-structure for four players



(b) Game-structure for two players

Fig. 2: Versions of pebble-pushing game, *baa-baa*

Play paths are equidistant and equiangular from the origin for fairness. Selina described this game as "*special for learning to measure lengths*" using arbitrary or non-standard units. It is one of the few games with unique fractional units for length: *kunyinti* designates a half unit and *kukuriku* designates a quarter unit of measure. Children use their hand-span and foot-length to measure scores. As a result, they can experience the problems with using arbitrary units of length. Selina explains why this game is appropriate:

> *When the line increases and you are using the palm, hand spans are not the same. So you want to tell children that all measurements are not equal. Secondly, when you measure and the line extends longer, you stop using your palm because you will be wasting your time. You use your legs* [strides]. *So it means short distances have measurements* [instruments] *and long distances also have theirs.*

Selina described the mathematics involved in this game as counting, measuring, and drawing lines.

*Stone-passing game, kuriyee-kuriyee: an instructional tool for basic arithmetic*

*Kuriyee-kuriyee,* is a stone-passing game played by children and young adults of both genders. Unlike other games requiring a limited number of players, there is no limit in this game. At least two people can play but "*[t]he fun and learning is best when more than six are involved.*" Players squat in a circle and in front of each player is a marked "*spot*" to restrict the positioning of the stones. Play involves players simultaneously picking up and passing stones to each other in a continuous clockwise fashion according

to the rhythm of a song. Figure 3 shows the arrangement for playing the game for five players.

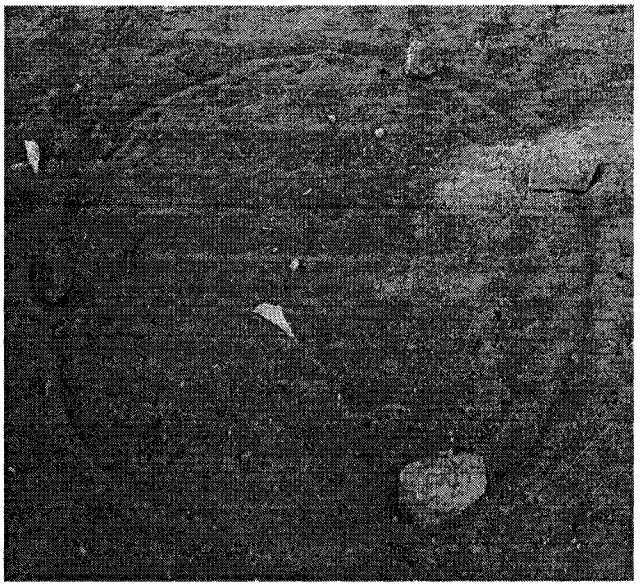


Fig. 3: Arrangement of stone-passing game, *kuriyee-kuriyee* for five players

Play is governed by four rules. (1) The number of stones must be equal to the number of players. (2) Stones are picked up and placed at the marked spots according to the rhythm. (3) A player is eliminated if he or she is unable to pass the stones according to the rhythm resulting in more than one stone on his or her spot. (4) When this happens the stones are reduced by one.

Jane conceptualized the game as particularly interesting for children as she says it encourages them to think and to coordinate their mental and motor skills. Edith feels it teaches counting. She explains how counting comes in the game:

> *The counting comes in before the game goes round ... They count the numbers: one, two, three, four* [stressing on each count number]. *If it is five then the pupils will say five and everybody must pass* [a stone] *to the next person and it will go*

> *round. Each person has to look for his* [or her] *stone and they can identify their stones. ... The game will move on if there is no mistake. They will sing. When they finish singing and if it is correct, they will sing again. They will count the numbers again and it moves on.*

It is the movement and the sound produced that are matched to counting aloud. One movement of a stone produces a single sound when it hits the ground and corresponds orally to "one"; two movements produce two sounds that correspond to "two" and so on. Edith clarifies the process as to how the stone sounds relate to counting.

> *It is the moving round and the sound of it. It will be making 'gbrai', 'gbrai'* [with a demonstration of a bang on the table and stressing on the sound] *so if it is one (clap), two (clap) three (clap) four (clap) f..i..v..e (clap)* [clap representing the sound]. *You stop on the fifth one. Let's say you are counting numbers from zero to five. So first 'gbra' means one... second 'gbra' means two. I write numerals on the board one, two three, four, five. When they count to a number, I write that on the board.*

In addition to counting and addition, Jane suggested that subtraction is deduced in the course of play. If there were seven students in a group, "*when one is out it means ... seven minus one*."

*Pebble-sowing games, daha: games of strategy*

*'Bie'* is a generic name for games in which pebbles are thrown, or sown. It may be referred to as *daha/bizie* among males or *bisogi, basinkolee* or *iri maa yi* among females. *Daha/bizie*, a pebble 'sowing' game of strategy, "*is very engaging*" and if good players "*sow*" their pebbles well "*it can take* ... [an] *hour before a game is over*" (Selina). It is

played by two individuals or two pairs. Traditionally, it is a male game but anyone may play.

The game has either a "*six-by-six or five-by-six*" grid of circular holes 3.0 to 4.0 cm wide and 1.5 to 2.0 cm deep dug in the ground. According to Gevase, it is designed to serve a "*multi-purpose function of incorporating other games in the single structure.*" Covering four rows of the six-by-six grid or three rows of the five-by-six grid with sand yields a new game structure called *basinkolii/bie eŋbu* or *iri maa yi*. Similarly, covering rows and columns until you have a three by three grid creates another new game of nine-holes called *bisiri*. Structures of the versions of the game are in Figure 4.

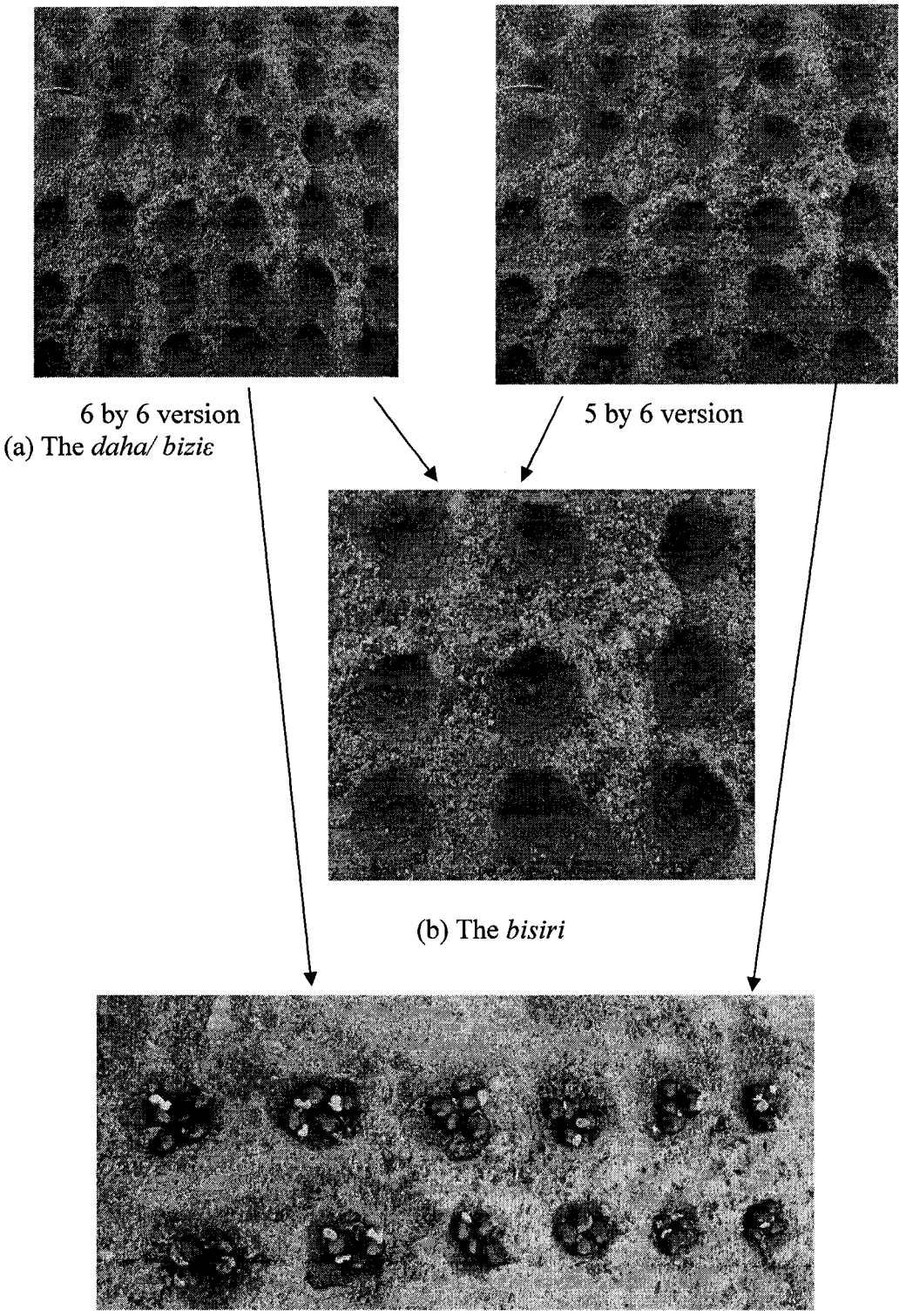



Fig. 4: Versions and transformations of pebble-sowing games, *daha*

Gevase describes *daha* as a game of strategy that forces a player to think like a mathematician to the extent that "*if you don't have knowledge in mathematics .... you can not win.*" A player has to do mental calculations from the onset of play to know when and where to put a particular pebble. Two different kinds of pebbles or different coloured materials are used. Gevase describes how the game is played.

> *You put in* [sow] *your pebbles in turns. You just put around but the essence of the game is to have what is termed 'nuori' in Dagaari,* [literally] *meaning 'mouth',* [and metaphorically meaning a score zone] *where three of the pebbles of the same colour can easily be in line. Strategic play begins after all pebbles are sown. If three pebbles of the same colour are in line then it means you have won a pebble of your opponent. So you just remove one pebble of your opponent for keep. It will continue in that way till the person or the group that will not be able to create any mouth again gives in. That is, if an opponent will not be able to make a straight line with the pebbles it means that fellow is the loser.*

Playing this game involves strategizing to create a score zone ('mouth') for a score when three pebbles of same kind (colour) are in a line (vertically or horizontally without a hole in between). Players strategically move pebbles to block the opponent's chances of creating a winning zone while enhancing their own chances of creating one. Thinking and conceptualizing possible movements and structures in order to capture the opponent's pebble is central to playing this game.

Play is governed by four rules namely: (1) Four pebbles cannot be in line. If that happens, it is a "foul" and the opponent removes all four pebbles; (2) After your opponent removes all four pebbles, either you (i) remove three of the opponent's pebbles

and the opponent takes the lead to play, or (ii) remove two of the opponent's pebbles and then take the lead; (3) In the course of putting the pebbles in the holes (pebble sowing) a player cannot have three pebbles in line (horizontally or vertically); and (4) During play, a pebble is moved only one space provided there is an empty hole either horizontally or vertically.

As a game of strategy, it involves several mathematical concepts and skills. "*Angle, and lines, addition, mathematical reasoning*" and counting are embedded in the game. The player has to "*mentally count*" the number of holes a particular pebble will be moved to increase the chance of winning. The game "*involve*[s] *a whole lot of math and the concepts are many*" Gevase concluded. Apart from strategizing, *Daha* also involves visualizing shapes, and the physical movement of pebbles.

*Jumping game: group ampe as a counting and adding game*

*Ampe*, a jumping game, is mainly played by girls. It may be played by two individuals or two groups of about four to six girls. Either two individuals or two groups of an equal number of players line up facing each other in a one to one correspondence. The first thing they do is choose between having the *"same"* feet match *or "opposite"* feet match. For example, if they choose "same" it means that either both right feet or both left feet will match. If they choose "opposite" it means that one girl's right foot will match the other girl's left foot. The two players then start playing by clapping and jumping while kicking their feet according to a rhythm. During play, if players kick the "same" foot simultaneously, then the player who has chosen "same" "*wins otherwise, the opponent wins.*" If played as a group game, individual pairs take turns as players

compete to win for their groups. If group A is playing with group B (each having four players), one player in group A, can play against all the four players in group B. For example, player $A_1$ will start playing with $B_1$. If $A_1$ succeeds, she moves to $B_2$ then to $B_3$ and then to $B_4$. Winning against all the players gives group A, a win. On the other hand if $A_1$ wins against $B_2$ and $B_3$ but fails with $B_4$, that is when $B_4$ "*catches*" $A_1$, $B_4$ then takes on $A_2$ then $A_3$ and so on. In order to win the game, group members must jointly beat all the opponent members or one player from the group plays everyone from the other group and beats them all. "*While they play, they will be counting*" as they move from person to person. From this activity, children will "*know they are counting in steps.*" From "*zero, they go one, two, three and so forth.*" This game may help children visualize addition on a number line more easily from the formation of the play. In this play form, "*they learn the mathematical ideas faster.*" The game helps children in their mathematical language development because "*when they are counting, they don't count in the local language. They rather count in English language*" (Martha). Through the game, children can become fluent in counting.

In my experience there are many cultural or traditional African games that could be used in the primary mathematics classroom for different purposes. The five games I have described illustrate a range of typical traditional games in Ghana.

## Concluding Remarks

In this chapter I examined craft knowledge as a conceptual framework for the study. I described craft knowledge as insights possessed by professional teachers and used in their day-to-day practice in response to specific situations. Its content is personal

and varies from individual to individual. In curriculum implementation, teachers rely on their craft knowledge to make the curriculum accessible to learners. Teachers' craft knowledge is heavily influenced by three sources: experience, current situation, and the teacher's vision of teaching.

In addition to craft knowledge as a conceptual framework, I examined the use of games in the mathematics classroom to understand them as activities with integrated opportunities for the mathematical development of the child. This sets the basis to understand the theoretical and practical justification for cultural games as opportunities to address curriculum reforms. Games potentially provide children with tools for learning, motivation, curriculum relevance and to bridge the home-school gap.

At present, I am not aware of the existence of literature on Ghanaian teachers' experiences and perspectives on cultural games in mathematics. It is the absence of understanding of teachers' understanding and use of cultural games in the Ghanaian context that this study was designed to address. The approach towards gaining access to teachers' experiences and perspectives regarding the use of cultural games will be examined in the next chapter.

# CHAPTER III

# METHODOLOGY

In this chapter, I discuss the rationale for the research design, the use of a constructivist-interpretive paradigm, the research context and participants, the data collection, and the data analysis in my quest to understand primary school teachers' experiences and perspectives in the use of games in mathematics classroom. I also examine the limitations and delimitations of the study, the ethical issues, and my role in the research project.

## Rationale for the Research Design

Mathematics education researchers in past decades have focused extensively on children's learning. In recent years teachers' perspectives are being examined from a broader perspective (Chapman, 1997; Skott, 2000). According to Cooper and McIntyre (1996) a curriculum framework within which teachers operate will be sensible and useful only if it takes into account how teachers do their work and why they work as they do. Understanding primary school teachers' experiences regarding games as an instructional strategy in Ghana's primary mathematics curriculum has not been explored.

According to Doyle (1990), the mode of inquiry on constructs and interpretations of pedagogic practice makes "explicit the implicit knowledge teachers deploy in interpreting classroom scenes and bringing in knowledge of content, pedagogy, and management in the enactment of the curriculum" (p. 16). The process of illuminating teachers' experiences is inductive, and requires a set of varied methods for uncovering

deeper meanings (Aubrey, 1997). I used both quantitative and qualitative methods to gain breadth and depth of information and understanding into teachers' experiences and perspectives with games.

Although I intended my research to be primarily a qualitative study, in order to collect demographic information and initial information on teachers' experiences and perspectives, I used a questionnaire. The responses to the questionnaire helped to identify general categories that I could later explore qualitatively through interviews with a small number of participants. This preliminary quantitative method in a qualitative study "brings different strengths together in the same research" (Morgan, 1998, p. 362).

Merriam (1998) recommends qualitative study as particularly suitable for discovering and understanding the processes, perspectives and world views of people. Since qualitative research emphasizes "processes and meanings" (Denzin & Lincoln, 1994, p. 4), I used qualitative methodology to gain access to "the substance and logic of teachers' professional craft knowledge" (Brown & McIntyre, 1993, p. 109) experiences in the use of games in mathematics in the Ghanaian context.

Smith (1993) argues that for an inquiry to be truly adequate to its subjects, it must undertake the interpretations of the reasons, motives, and intentions people have for their actions. Doing a qualitative study directs attention to interpretations of the participants under investigation. The overall intent of a qualitative study, as Merriam (1998) noted, is descriptive, interpretive, analytic and evaluative. I value Peshkin's (1993) idea that "[t]he travels that we take down the 'infinite path' can only be facilitated by a type of research that gets to the bottom of things, that dwells on complexity, and brings us very close to phenomenon we seek to illuminate" (p. 28). A qualitative approach to research provides

a methodological flexibility towards understanding teachers' experiences and understandings of cultural games in their natural settings.

In the study, I investigated game-based pedagogy among teachers, as well as teachers' decisions for what, when, why and how games are used or not used. Making teachers' experiences of games explicit is a social and interpretive process. My aim was to capture teachers' holistic experiences and perspectives within a constructivist framework or paradigm.

## Constructivist-Interpretive Paradigm

My study is based on a 'constructivist-interpretive' paradigm (Denzin & Lincoln, 1994, p. 13). This paradigm focuses on the social construction of knowledge and relies on subjective constructions of multi-realities. People come to participate in social practices from an individual set of sociocultural experiences but knowledge emerges as a collection of multiple subjectivities. Constructivist researchers hold the view that knowledge and its acceptance as knowledge can be explained using sociological tools.

Researchers (Guba & Lincoln, 1994; Lincoln & Guba, 2000) present constructivism as an inquiry method that adopts a relativist's ontology, a transactional and subjectivist epistemology and a dialectical methodology. It stresses a "socially constructed nature of reality" and recognizes the existence of multiple realities or co-existence of multiple "knowledges" and understandings (Guba & Lincoln, 1994, p. 4). Appropriating understandings is a process of refinement and transformation and the outcome is an interpretive reproduction (Evaldsson & Corsaro, 1998; Rogoff, 1990). Thus, in cultural game practice, multiple realities or perspectives are bound to exist as

pedagogical content knowledge is uniquely constructed by individual teachers. This knowledge, understood as mental constructions, is experientially based, local and specific (Guba & Lincoln, 1994; Lincoln & Guba, 2000). Mathematical knowledge on games is symbolically constructed with understanding based on the rules of the game, the materials and actions involved. A mathematical concept defined by a game is 'what we agree it is' as a mathematical idea and "does not become clarified by any one person's construction" (Peshkin, 1993, p. 28).

The constructivist view of knowledge construction is embodied in game-based pedagogy in two ways. First, games echo the "socially constructed nature of mathematics" and second, by building games activities into mathematics lessons, "we can have a range of opportunities for inventing mathematics" (Davis & Pettitt, 1994, p. 82). However, the knowledge required to realize these benefits is an individual construction in social interactions in the process of meaning making. Mathematical practices of games that teachers bring to instruction are understood as social constructions that are socially, experientially and contextually based. As such, the emerging knowledge in this research is essentially an interpretation of multiple constructions that teachers bring to practice through a dialectical process.

Since the study is to enable me to explore teachers' experiences and perspectives regarding games and to build my own pedagogical frame for mathematics teacher development, using a constructivist-interpretive paradigm has merit. Interpretive inquiry produces outcomes that "explain or create generalizations, develop new concepts, elaborate existing concepts, provide insights, clarify complexity, and develop theory" (Peshkin, 1993, p. 23). Interpretive research, as Merriam (1998) noted, regards education

as a process and understanding the meaning of this process constitutes knowledge. Interpretations do not only engender new concepts but also elaborate existing ones.

## Research Context

In Ghana, primary schools (grades 1-6) constitute the first level of Basic Education. The study was conducted among primary school teachers in both rural and urban communities. Rural communities are primarily culturally homogenous and these communities maintain their social life mainly through what the culture provides. Most Ghanaian rural communities have not yet come under the influence of modern technological forms of games like video or computer games and so their game activities are purely culture specific. On the contrary, urban communities comprise a mixture of cultural groups due to the inflow of workers across cultures. These urban communities may have access to some technological-based games and game activities may become a mix of cultural and technology-based. Urban communities are materially rich in both cultural and common games and teachers in such communities may experience such resources in the communities' social life. Nonetheless, any Ghanaian community provides rich sites for cultural games where they are used for authentic cultural, affective, recreational, and socialization purposes.

In Ghana, teachers teach in a recommended maximum classroom size of 46 pupils. However, in extreme cases there can be fewer than ten pupils where the enrolment is low or more than 80 pupils, especially where teachers have to "multi-class teach" by combining different classes (Ministry of Education [MOE], 2004, p. 7).

School materials are provided by the central government and all schools strive to follow the prescribed national curriculum. Topics and activities are sequentially arranged in the syllabus to guide teachers but teachers may re-order the topics in a way that facilitates children's systematic conceptual development and understanding. The ethos of teaching is such that children virtually accept what mathematics is taught without question. Essentially, children learn and practice the mathematics that is promoted by their teachers who decide what, how, and when to teach and to assess.

## Participants and Sampling Procedure

The study involved primary teachers from the Upper West Region of Ghana. All participants were certificated professional teachers who graduated from teacher training colleges. The region has five administrative districts and participants were selected from the Wa Municipal District for convenience. The district has 52 primary schools in both urban and rural communities. In qualitative research, Merriam (1998) recommends a non-probability sampling strategy and suggests developing sampling criteria to guide participant selection. Purposeful sampling, a widely used non-probability strategy in educational qualitative studies, was applied to this study. Schools were selected based on their accessibility and the opportunity divide that classified a school as rural or urban. To account for both urban and rural differences, a sample of 30 schools, 11 rural and 19 urban locations, was selected.

From the sampled schools, 240 of a possible 289 participants consented to participate in the questionnaire. A total of 164 of the 240 questionnaires distributed were returned. Eight of the returned questionnaires were rejected because they were

incomplete. The remaining 156 questionnaires (53 males, 103 females; 55 rural, 101 urban) are the basis of the quantitative data collected.

The number of teachers representing the various primary grade levels who participated in the questionnaire is shown in Table 1.

**Table 1: Grade levels of participants surveyed ($n$ = 156)**

| Level | KG | P1 | P2 | P3 | P4 | P5 | P6 | DHT* |
|---|---|---|---|---|---|---|---|---|
| Number of teachers | 2 | 26 | 26 | 24 | 29 | 20 | 21 | 8 |

(DHT* means Detached Head Teacher. They primarily do administrative work but occasionally teach when needed.)

As noted, the teachers surveyed represented all the primary grades including Kindergarten, which recently became part of the public education system. The questionnaire also determined that the 156 participants spoke mainly three languages: *Waali,* (58%), *Dagaari* (40%) and *Brifor* (2%) in addition to speaking English which is the official language of instruction. Participants' teaching experience ranged from six months to 36 years with an average of 12.5 years.

The questionnaire also identified teachers who were users and non-users of games in teaching mathematics as well as teachers who were willing to participate in an interview process. In recognition of Merriam's (1998) advice that what is needed in a qualitative study is an "adequate number of participants" (p. 64) that can help answer the research question, ten (seven users and three non-users) out of the 29 teachers who consented to be interviewed were selected. For the "users" category, I chose seven participants based on their experience, geographic location, variety of known and played games, gender, and the level taught. Six of the seven game users incorporated both

cultural and common games in their classrooms. I selected one participant who used only common games. I included this participant because I thought it would provide an interesting link between the users and the non-users of cultural games. For the "non-users" interview group, three participants were selected based on their location and the extent of their experience with a variety of known and played games. I thought the variation of games played would be an important factor for understanding teachers' pedagogical practices. Some of the characteristics of the ten participants who were interviewed are shown in Table 2.

**Table 2: Characteristics of interviewed participants ($n$ = 10)**

| Teacher [pseudonyms] | Gender | Upbringing | Current School Location | Experience (years) | Grade taught |
|---|---|---|---|---|---|
| | | *Users of games* | | | |
| Martha | Female | Rural | Urban | 17 | 2 |
| Edith | Female | Rural | Urban | 20 | 2 |
| Jane | Female | Urban | Urban | 30 | 3 |
| Gevase | Male | Rural | Rural | 4 | 5 |
| Selina | Female | Rural | Urban | 15 | 5 |
| Paul | Male | Urban | Rural | 6 | 1 |
| Vero* | Female | Urban | Urban | 20 | 1 |
| | | *Non-users of games* | | | |
| Vida | Female | Rural | Rural | 5 | 2 |
| Ruth | Female | Rural | Urban | 15 | 2 |
| Doris | Female | Rural | Rural | 19 | 3 |

(*Vero used games but not cultural games)

Of the participants that were interviewed, their teaching experience ranged from four to thirty years and they were currently teaching in Primary 1, 2, 3, and 5. All seven game users had taught both lower and upper primary levels.

## Data Collection/Sources

Researchers have recognized that different methods of data collection have different strengths (Addison, 1989; Denzin & Lincoln, 1994; Morgan, 1998; Peshkin, 1993). Addison (1989) points out that a questionnaire alone is inadequate for capturing the understandings of social practices and context of participants in ongoing social situations. Similarly, Denzin and Lincoln (1994) assert that, "[n]o single method can grasp the subtle variations of ongoing human experience" (p. 12). A single method only provides a glimpse of reality (Peshkin, 1993) but "multiple sources lead to a fuller understanding of the phenomena" (Bogdan & Biklen, 2003, p. 107). Also, collecting both quantitative and qualitative data in a single study has "proved to be a powerful means of digging into teachers' knowledge, perceptions, views, beliefs, and understandings of a range of pedagogical practices" (Moyles & the SPRINT team, 2003, p. 4). Morgan's (1998) complementary model for integrating quantitative and qualitative data in a single study guides my data collection process.

I collected both quantitative and qualitative data in two stages over a four-month period. I began with an initial pilot survey in order to refine the questionnaire. I then distributed a revised questionnaires to 240 participants. Data was also collected through two interviews with a sample of ten teachers selected from the questionnaires. Additional data was collected through sample games from the teachers identified as using cultural games to teach mathematics.

Below is a timeline that briefly illustrates the data collection and analysis process followed by a more detailed description of the data collection sources.

*Research timeline: January to August 2006*

| Date | Activity |
|---|---|
| Jan. 8th | Municipal Director of Education of the Wa Municipal Education Office received my letter requesting permission to conduct my research in the schools. |
| Jan 10th to 20th | I piloted and revised my questionnaire. |
| Jan. 28th | I left for the research site, Wa, a distance of over 740 km. |
| Jan. 30th | I visited the Municipal Director of Education Office to enquire about the response to my letter. At this time, the research was approved. |
| Jan. 31st to Feb.10th | I visited 26 primary schools to meet with Head Teachers to explain my research, seek teachers' consent and distribute 190 questionnaires. |
| Feb. 20th to 24th | 122 questionnaires returned; I began first analysis. Participants who had agreed to be interviewed were identified. |
| Mar. 1st to 10th | I contacted teachers to discuss interview dates and times at their convenience. |
| Mar. 12th to 18th | I conducted my first set of interviews with the ten participants. I transcribed and analyzed the tapes alongside the interviews. I also explored opportunities for more volunteers to complete my questionnaire. I visited four more schools, and had 50 more volunteers to complete the questionnaire. Also, some teachers who did not submit their questionnaires originally handed in their questionnaires during this period. Forty-two more participants submitted questionnaires during this time. This brought the number of respondents to 164 teachers. |
| Mar. 18th to April 7th | Continued to transcribe and analyze interview data. |
| April 8th to 12th | I gave transcribed materials to participants to read through for member checks to make revisions and return. |
| April 13th to 18th | I conducted my second set of interviews. |
| April 18th to May 15th | Analysis and transcription continued. |

| Date | Activity |
|---|---|
| May 15th to 28th | I contacted participants for final member checks of the transcriptions, and additional information teachers wanted to add. |
| June to August | Continued with in-depth analysis of all data. |

*Piloting the questionnaire*

In this first phase of the study, I piloted the questionnaire with ten teachers (3 males and 7 females), over a two week period. I made use of volunteer teachers from the University Primary School and teachers from other schools within the University community. The essence of piloting the survey was to provide "conceptual clarifications" and to do a formal "dress rehearsal" (Yin, 2003, p. 79) to eliminate ambiguities in the items. Participants for piloting were selected based on convenience, accessibility, and proximity. I did not know any of the participants beforehand.

Based on the responses, the word 'traditional' was inserted in items 12 and 16 to read "What types of traditional games were played in the community when you were a child (e.g., sand games, etc)?" and "What traditional games do children currently play in the community you teach?" instead of "What types of games were played in the community when you were a child (e.g., sand games, etc)?" and "What games do children currently play in the community you teach?" Even though the initial items opened the latitude for responses to include both categories of games, the change was necessary because respondents tended to focus more on "Western" games instead of the cultural or traditional games that were a primary focus of the study.

*Administering the revised questionnaire*

Administering the revised questionnaire constituted the second phase of the study. The questionnaire consisted of 29 questions that sought participants' background experiences with games during childhood, adulthood, in school and their use or non-use of games in classroom mathematics practice. In addition, the teachers' perspectives of the purpose and the advantages and disadvantages of using games to teach mathematics as well as what mathematics these games might teach were sought (see Appendix A for questionnaire).

I visited each school to discuss my research with the Head Teachers and staff as well as to share the purpose and intent of the study, and to seek participants' consent (see Appendix B for participant consent form). Most Head Teachers set a time where they gathered all the teachers to listen while I explained my research. A few Head Teachers asked that I return a few days later when they had arranged a time for me to meet with the teachers. When I met with all the teachers, I gave each teacher a letter explaining my research and responded to their questions. Those who were interested were given the questionnaire. Teachers were asked to give the completed questionnaires to the Head Teachers and were told that I would return to collect them in two weeks. Most teachers completed their questionnaire within a week. (Many teachers had time available as they had student teachers in their classrooms at the time the questionnaires were distributed). By mid-February I had received 122 questionnaires. Although I was able to collect an additional 42 questionnaires over the next six weeks, interview participants were chosen from this initial group of 122 respondents.

*Conducting the interviews*

Conducting individual interviews was the main aspect of the last phase of my data collection. I used in-depth informal "conversation interviews" (IDICIs) with the ten selected teachers identified through the questionnaires. Conversation is discursive as well as informational (Goldsmith & Schifter, 1997) and offers an opportunity to examine fundamental issues about teaching and learning with teachers. The purpose of these conversations was to help address the questions on teachers' experiences and practices in relation to the use or non-use of common and cultural games in the mathematics classroom.

The essence of using IDICIs is to understand the complex teaching behaviours of participants "without imposing a priori categorization that may limit the field of inquiry" (Fontana & Frey, 2000, p. 653), and to avoid the problems of limiting the participant's voice (Mishler, 1986). It permits participants to create their own responses and to voice their experiences unconstrained (Creswell, 2002). IDICIs are unstructured and flexible. Their unstructured nature allows "latitude in the breadth of relevance" so that what is relevant to the participant is freely pursued (Fontana & Frey, 2000; Freebody, 2003, p. 133).

As meaning is negotiated and an ongoing process in interpretive inquiry, I interviewed each of the ten teachers at least twice excluding informal chats when the situation availed. I began my first set of ten interviews in the third week of March. All interviews were audio-taped and transcribed. Field notes were also written after each interview. A teacher was also hired to assist in the transcription of some of the tapes. Member checks occurred before the second interview in order to check the accuracy of

transcriptions and conversations. The second set of interviews occurred in April. A final member check of the data took place in the last two weeks of May. The interview sessions lasted on average an hour each and took place in the school premises, mostly after class hours. We met in empty classrooms or convenient and private locations. All interviews were conducted in English but occasionally, some words, especially names of games, were in the native language. Names of games were maintained but other native words were translated to fit the text and the literal meaning was put in brackets, where possible.

Given that constructivist learning theory suggests background knowledge, beliefs, and understandings that teachers construct influence their practice (Richardson, 2001), in the first interview sessions with both users and non-users of games I asked open questions about their classroom activities, perspectives on the benefits and concerns about using games, Initial Teacher Training (ITT) and professional development experiences on the use of games, awareness of games in the curriculum and their own learning with these games. With game users, I also sought information on the selection of games and the teacher's role in orchestrating children's learning through games.

I attempted to use open questions and I tried to engage participants in a reflective dialogue (Merry & Moyles, 2003) through which the researcher and teacher share ideas to develop understandings as partners. I used a 'non-directive probing' strategy (Brown & McIntyre, 1993; Creswell, 2002) for participants' experiences and practices on game use to clarify and to elaborate their ideas.

In the second interview, I probed further into the mode of game use among the users and the rationale for the non-use of games among the non-users. At this point, I

also made clarification requests for teachers to explain their assertions made in the previous interview (see Appendix C for sample interview questions).

### *Examining games used*

Answering a question Richardson posed to a renowned curriculum professor and philosopher, Joseph Schwab, about what education is required to teach mathematics, he said "you need to see the light at the end of the tunnel in order to teach mathematics" (Richardson, 2001, p. 290). Similarly, for teachers to use cultural games to teach mathematics, they need to see the mathematics these games can teach. Hence, I felt that examining and taking pictures of the games teachers used was an important aspect in my final phase of data collection. Cultural games are a manifestation of a culture's mathematical knowledge, actions and values. Physical samples of the games and their mathematical descriptions were the final source of evidence I collected (and were shared in Chapter II). I requested to see some of the games and how they are constructed on the ground or board (where possible). I also took pictures of some of the cultural games that teachers showed to exemplify or elaborate their practice. Collecting this data helped me examine teachers' conceptual knowledge of the mathematics embedded in these games.

## Data Analysis and Interpretation

In the first phase, I applied descriptive statistical analysis on some of the questions from the survey using frequency counts on categories such as users, non-users, games experienced, and views about cultural games. Frequency counts were converted to percentages. The second phase involved thematic analysis, which applied to all

qualitative data sources which explored teachers' experiences and practices of using games. By examining the subjective verbal/written expressions of participants' feelings, thoughts and descriptions of their pedagogical practice, I sought to understand their craft knowledge that influenced their practice of cultural game-pedagogy.

Constructivist-interpretive research should inform the improvement of instructional design, document collective mathematical practices and pedagogical reasoning. My analytic process was guided by themes and constructs related to the principles of using games in teaching mathematics (Kieff & Casbergue, 2000; Gerdes, 2001; Kamii with Livingston, 1994; Kamii with Housman, 2000; Van Hoorn, Nourot, Scales, & Alward, 2003). Also, the objectives of the study informed my analysis.

The analysis of participants' questionnaires, interview transcripts, lesson notes and game photos and artifacts enabled me to explore teachers' past and present experiences with cultural games, their perspectives of the purposes of playing games in the community, and advantages and challenges of using these games in the mathematics classroom. Participants' responses were analyzed for answers to a number of questions, including their own experiences with cultural games in their communities during childhood, in school and in their current communities of practice; participants' use or non-use of games in teaching; participants' perspectives of the purpose of playing games in their communities; and their perspectives on the advantages and challenges of using cultural games in teaching mathematics. I also analyzed participants' conceptual knowledge of mathematics in cultural games. In the analysis process, I focused on individuals before looking across for patterns and contrasts among teachers.

Interpretations are creative constructions. Tahta (1994) suggests interpreting mathematical practices in terms of the fruitfulness in improving understanding and practice of teaching and learning. Data from interview transcripts were segmented into meaningful categories which were later collapsed into themes. I relied on the "subjective verbal/written expressions" (Denzin & Lincoln, 1994, p. 12) of mathematical meanings provided by participants. From teachers' responses on the questionnaire and during interviews I sought to discover and to discern their experiences and perspectives in relation to their practice of using common and cultural games in teaching mathematics.

## Limitations and Delimitation

Denzin and Lincoln (1994) have drawn attention to the fact that there is no clear window into an individual's inner life and so it is humanly impossible for individuals to offer a complete account of their explanations and intentions. In this study, the degree of understanding participants had of cultural games may also be a limiting factor. As Peshkin (1993) points out, no method of data collection is absolute. In spite of multiple methods, it may not be possible to capture absolute views of individuals within the study. In particular, interviewing teachers is incomplete because it infers teaching mathematical formulations from teachers' accounts of what they think they do without knowing whether they actually do it (Ball & Bass, 2000).

This study is limited to teachers within one District in the Upper West Region in Ghana. Because the study was to discover teachers' perspectives, I did not examine children's perspectives on these resources in learning mathematics. The content analysis of curricular materials and children's perspectives could be areas for further research.

## Trustworthiness of the Study

Qualitative research has often been criticized as lacking formal conventions of reliability and validity. However, since the early 1980s qualitative researchers have proposed alternative criteria for trustworthiness to check against the formal conventions of positivism. The proposed criteria include credibility, dependability, and transferability that parallel internal validity, reliability, and external validity respectively (Guba & Lincoln, 1994). These criteria stress the situated, relational, and textual structures of qualitative experience.

Credibility which pertains to the constructivist paradigm and parallels the internal validity in the positivist research (Mertens, 1998), tests the correspondence between the research participants' social constructs and the way the researchers interpret their viewpoints. Gall, Gall and Borg (1999) suggest researchers comprehensively contextualize their studies by providing clear and meaningful links between questions, data, analysis, and conclusions throughout the research process, and situate the report in its context to achieve credibility. Besides contextualizing the study, member checks (Merriam, 1998) have been suggested among others as a strategy for enhancing credibility.

In the constructivist paradigm, dependability is analogous to reliability in the postpositivist paradigm (Guba & Lincoln, 1994) and is used to describe the stability of data over time. According to Schumacher and McMillan (1993), dependability measures the "degree to which the interpretations and concepts have mutual meanings between participants and researcher" (p. 391) and the extent to which the findings can be replicated.

Mertens (1998) describes transferability as the extent to which results can be generalized to other situations. Transferability is identified as the qualitative analogue to external validity (Guba & Lincoln, 1994). Merriam (1998) suggests "thick descriptions" which comes from an anthropological background referring to "complete, literal descriptions of the incident or entity being investigated" (p. 30) as a means of establishing transferability. The essence of the thick descriptions is to create verisimilitude (Guba & Lincoln, 1994) for readers to have a feeling they have experienced or could experience the events being described.

Although credibility, dependability, and transferability of data are subjective issues subject to criticisms, contextualizing interpretations, using "thick descriptions" and member checking as discussed above, have been used to address any criticisms against qualitative research. Being aware that interpretation is not an individual affair (Bogdan & Biklen, 2003), I attempted not to reject ideas that did not match my own. Rather I negotiated ideas with participants. I considered diverse interests and viewpoints as they presented themselves in the study, and I attempted to use thick descriptions to substantiate and illustrate assertions made by individual participants to illuminate the contexts. In both interview sessions, I used member checking where transcripts from individual interviews were given back to participants to allow them to add-on, delete or revise transcripts to better reflect their thinking, beliefs and practices.

## Ethical Issues

Gaining access involves receiving official permission and laying the groundwork for acceptance at the research site. Bogdan and Biklen (2003) advised that gaining access

through an overt approach, whereby data is collected openly, gives the researcher freedom to investigate and a greater access to a wider range of settings. They advised that permission should be sought at all levels connected to the study. Consequently, letters were written to seek permission from the Municipal Directorate of Education, (see Appendix D) and the Heads of Primary Schools and participants (see Appendix E to F). Before conducting my interviews, I explained to participants the purpose of the study, its nature and what would be done with the findings. I also made them aware that the study was not an assessment of their practice but essentially a learning process for me to understand the realities of game use in the classroom. I asked them to sign consent forms that indicated their willingness to participate and their rights to opt out anytime during the research without hindrance. All participants were assured of anonymity. I used pseudonyms as names of the teachers in fulfillment of the ethical agreement. Since in qualitative research, the researcher-participant relationship is important, only volunteers were considered for this study. The research was conducted in accordance with the ethics review provisions of the University of Alberta.

## Role of the Researcher

According to Ellis (1998) interpretive research is characterized by "openness, humility, and engagement" (p. 18). Newkirk (1996) points out that teachers being studied by university researchers might feel some professional discomfort because of the hierarchical system in which they find themselves. However, in the spirit of good relationship with participants, as well as the researcher being open and honest, participants can feel comfortable to provide rich information on what is requested.

Lincoln and Guba (2003) suggested participative mode of inquiry towards building continuous relationships in a face-to-face inquiry process. As I did not know any of the participants beforehand and was cognizant that participants may experience discomfort by virtue of my position, when I first met all the participants I impressed upon them the value of their work that has gone unrecognized. I made them aware that the study was our collective effort towards improving the mathematics education in the community, and explained that by working together we could document their work to inform policy and practice. I also made a number of contacts with participants to establish a rapport prior to the commencement of the interviews. I again explained the purpose of my research and the interview, and gave an authentic presentation of myself as a learner and a compatriot in the same profession. I tried to remain non-judgmental, sensitive and respectful to participants throughout all my interactions with them.

According to Merriam (1998), a qualitative researcher must tolerate ambiguity, show sensitivity, and have good communicative skills in data collection process. Being sensitive in interviewing involves "knowing when to allow for silence, when to probe more deeply, when to change the direction of the interview" and when to play a detective role (Merriam, 1998, p. 22). The process involves interpreting information as it is being collected to avoid contradictions and to give insights to new evidence.

Just as a researcher doing a study of the nude beaches may have to disrobe and casually stroll in the nude (Fontana & Frey, 2000), I assumed the role of a 'pupil' learning from 'experts' on the use of games to get at understanding. In this role, I wore 'a listening ear' that listens carefully and "acts like a sponge, absorbing and drawing in information, maintaining a spirit of inquisitiveness, rather than a judgmental or

evaluative manner" (Morse, 1994, p. 28). In sum, I entered the research setting as a stranger since familiarity can dull the researcher's ability and sensitivity of data collection. I also entered the research setting with a personal bias that cultural games are important for children's learning of mathematics. However, I tried to account for this bias by focusing on understanding how these games are used or why they are not being used.

# CHAPTER IV

## THE QUESTIONNAIRE

In this chapter, I examine, interpret and discuss the data from the completed questionnaires. The questionnaire consisted of 29 questions, both closed and open-ended, that addressed participants' experiences with games during childhood and adulthood and their use of games in teaching mathematics. In addition, the teachers' perspectives of the purposes and the advantages and disadvantages of using games to teach mathematics as well as their understanding of the mathematics within games were sought (see Appendix A for questionnaire)

In all, I requested participation from 289 teachers in 30 schools. I received consent from and distributed questionnaires to 240 teachers. Over a six week period, 164 questionnaires were collected resulting in a return rate of 68%. Eight of the returned questionnaires were rejected due to insufficient completion. The remaining 156 questionnaires were used in the analysis. Although teachers were asked to respond to all the questions, they were not compelled to do so. As some teachers left out a few questions, the total number of respondents varies across questions. The 156 participants included 53 males and 103 females and 55 rural teachers and 101 urban teachers.

The analysis of the questionnaires includes an examination of the participants' past and present experiences with games, their use and non-use of games in classrooms and their perspectives on the purposes, advantages and disadvantages of games.

## Community Games: Past and Present

The survey included several open-ended questions about the types of games participants played and observed in their communities when they were children and the games children currently play where they presently reside. I classified the games into eleven categories according to their traditional modes of play, namely: stone-passing/-throwing games, hopping games, jumping games, searching games, aiming games, pebble/marble-pushing games, pebble-sowing games, pulling games, song games, comparing games, and dancing games.

In order to gain background information on teachers' experiences and familiarity with cultural games, I asked the following two questions: "What types of traditional games were played in the community when you were a child?" [3] and "Which games did you play?" Table 3 below summarizes the cultural game categories that teachers indicated they had observed and participated in as children. I separated the participants' responses into rural and urban communities and determined the percentage of teachers who had recorded observing and participating in games.

[3] As mentioned in Chapter 1, the terms "cultural games" and "traditional games" as referenced on the questionnaire, are considered to be synonymous.

**Table 3: Cultural games that teachers observed and participated in as children ($n$ = 151).**

| Game classification | Rural Community ($n$ = 53) | | Urban community ($n$ = 98) | |
|---|---|---|---|---|
| | Observed (%) | Participated (%) | Observed (%) | Participated (%) |
| Pebble-sowing games | (47) 88% | (28) 53% | (47) 48% | (42) 43% |
| Stone-passing/-throwing games | (43) 81% | (39) 74% | (67) 68% | (43) 44% |
| Searching games | (40) 76% | (21) 40% | (33) 34% | (25) 26% |
| Jumping games | (35) 66% | (26) 49% | (53) 54% | (42) 43% |
| Hopping games | (26) 49% | (15) 28% | (45) 46% | (34) 35% |
| Pebble/marble-pushing games | (19) 36% | (17) 32% | (29) 30% | (27) 28% |
| Dancing games | (18) 34% | (10) 19% | (16) 16% | (11) 11% |
| Aiming games | (7) 13% | (7) 13% | (12) 12% | (10) 10% |
| Song games | (9) 17% | (6) 11% | (10) 10% | (7) 7% |
| Pulling games | (5) 9% | (4) 8% | (7) 7% | (6) 6% |
| Comparing games | --- | --- | (1) 1% | (1) 1% |

Table 3 indicates participants growing up in rural communities observed a greater variety of games being played as children compared to teachers who grew up in urban communities. More than half of rural-raised teachers remembered children engaged in pebble-sowing, stone-passing, searching, and jumping games; more than a third of teachers also observed hopping, pebble-pushing and dancing games.

Teachers raised in urban settings also remembered various community games, but to a lesser extent than rural-raised participants. More than half of the participants from an urban upbringing observed only stone-passing/-throwing and jumping games; a third or

more observed pebble-sowing, hopping and searching games. In all categories (except comparing games) participants raised in rural communities remembered games within that category played more frequently than teachers raised in urban centres. This suggests that teachers raised in rural communities have a broader familiarity with cultural games than teachers from urban centres.

As children, all teachers experienced playing at least one type of cultural game. More than half of the rural-raised teachers participated in stone-passing/-throwing and pebble-sowing games; a third also participated in jumping, searching and pebble-pushing games. Urban teachers remembered playing a smaller variety of games, but many of them also identified stone-passing and pebble-sowing as games they participated in as children. In all game categories except hopping and comparing games, rural teachers reported participating in games as children more frequently than urban teachers.

While I cannot be certain whether the teachers accurately reported their own observations or their experiences as children, the results are not surprising. Most rural communities in the past and present have no access to technologically powered social activities and inhabitants have to rely on what the culture and community provide for socialization. As stated by one teacher, "*there are no entertainment facilities like TV's and what not, when it is moonlight or free times, we come out and play these games to have fun*"[4]. Urban communities have more access to technologically powered social devices like television sets (TV), and video games.

Although rural-raised teachers are likely more familiar with a broader range of games compared to their urban counterparts, the categories of games all teachers seemed most familiar with are pebble-sowing and stone-passing games.

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[4] Remarks italicized and in quotes are from the teachers' questionnaire

To gain further understanding of teachers' awareness of cultural games in their present communities I asked, "What traditional games do children currently play in the community you teach?" Table 4 uses the same 11 game categories as in Table 3 and provides specific names of cultural games children currently play in the various school communities. The percentage indicates the number of teachers who reported observing students playing a game within that category.

**Table 4: Cultural games children currently play in the school communities (*n*=149)**

| Game classification | Examples | Observed (%) |
|---|---|---|
| Jumping | *Ampe*, rope jump | (115) 77% |
| Hopping | *Dansu bombo, gollaa/gonligonli* | (75) 50% |
| Stone-passing/-throwing | *Kuriyee-kuriyee and bisogi/bie lobu/ bie-ziɛbu* | (57) 38% |
| Searching | *Puonãã, pii-lo-lo, sogluu, mullaa* | (36) 24% |
| Pebble-sowing | *Daha/ bie, iri maa yi, basinkolee* | (30) 20% |
| Pebble-/marble-pushing | *Baa-baa/baakyiribu, damme* | (27) 18% |
| Dancing | *Aŋlee/aŋyee, koori/kauri* | (19) 13% |
| Pulling | *daabiɛ, moori* | (6) 4% |
| Song | *Gbingbin, foglunfu, duluu,* | (5) 3 % |
| Comparing | *Boŋsiŋãã* | (5) 3% |
| Aiming | *Furu, giihi,, piime tiɛbu, daayee,* | (2) 1% |

(Note: / denotes a different name or language function for the same game. For example, *bisogi / bie lobu/ bie ziɛbu* are three different names for the same game)

The responses indicated that jumping games, such as *ampe,* are observed by 77% of teachers across the regions surveyed. Hopping (50%) and stone-passing/-throwing (38%) are also games seen by many teachers.

These results differ from the teachers' experiences as children, particularly in the frequency with which they are observed. In 8 of the 11 game categories, fewer teachers now observe those games occurring than they reported observing as children. For example, the most common games participants observed and engaged in as children were stone-passing and pebble-sowing. Stone-passing was observed by 81% and 68% of teachers from rural and urban communities respectively; currently only 38% of teachers have seen this type of game played by children in their communities. Similarly, pebble-sowing was observed by 88% and 48% of participants from rural and urban communities respectively; it is now observed by only 20% of participants. Hopping games were observed by approximately half of participants as part of their own memories as children and also currently as teachers observing children in their communities. Jumping games is the only category that is observed substantially more frequently now than in the past.

These results suggest that the nature of games being played and the frequency with which these games are played have changed from when the teachers were children. Of particular note is the drop in participation for aiming games and song games. The extremely low participation of children currently playing aiming games in the communities is likely attributable to the potential danger of the materials. Apart from one game, *giihi duobu,* the rest of the aiming games involve the use of pointed piercing metal objects. The low participation of children in song games is particularly disconcerting as it signals a significant decline in an important aspect of our culture.

## Games for Mathematics Teaching

Of the 156 teachers surveyed in the Municipal District (Head Teachers inclusive) 47% (74 teachers) indicated that they used games at some point in time in their teaching and 53% (82 teachers) said they did not. The distribution of teachers who use and do not use games is as shown in Table 5. This table also shows the types of games used, if any.

**Table 5: Distribution of teachers using games for teaching mathematics (*n* = 156)**

| | Rural (55) | | Urban (101) | | Total (156) | |
|---|---|---|---|---|---|---|
| | # | % of Rural | # | % of Urban | # | % of Total |
| Did not use games | (30) | 55% | (52) | 51% | (82) | 53% |
| Used games | (25) | 45% | (49) | 49% | (74) | 47% |
| Common games<br>*Ludo, number games, etc* | (19) | 35% | (30) | 30% | (49) | *31% |
| Cultural games | (16) | 29% | (19) | 19% | (35) | *22% |
| Jumping<br>*rope jump, ampe* | (6) | 11% | (8) | 8% | (14) | 9% |
| Pebble- /marble-pushing games<br>*baa-baa/baakyiribu, damme* | (3) | 5% | (6) | 6% | (9) | 6% |
| Stone-passing/-throwing games<br>*kuriyee-kuriyee, bisogi* | (4) | 7% | (5) | 5% | (9) | 6% |
| Hopping<br>*dansu, bombo, gollaa/gonligonli* | (3) | 5% | (3) | 3% | (6) | 4% |
| Pebble-sowing games<br>*daha/bie* | (4) | 7% | (0) | 0% | (4) | 3% |
| Comparing games<br>*Boŋsiŋãã* | | | (2) | 2% | (2) | 1% |
| Song games<br>*gbingbin/gbilengbi, amina/* | | | (2) | 2% | (2) | 1% |
| Searching games<br>*puonãã, pii-lo-lo, sogluu* | | | | | (0) | 0% |
| Aiming games<br>*Furu, giihi duobu, piime tiɛbu* | | | | | (0) | 0% |
| Pulling games<br>*daabiɛ, moori* | | | | | (0) | 0% |

*(Notes: These numbers do not total 47% because 11 teachers indicated that they used both cultural and common games and teacher indicated she used games but did not specify.[It was assumed a common game])

Table 5 indicates that there is approximately a 50/50 split between users and non-users of games. While approximately half of the teachers use games, only 22% indicated that they use cultural games in their mathematics classrooms.

When rural and urban settings are taken into consideration, it appears as though slightly more urban teachers (49%) than rural teachers (45%) incorporate games of all forms into their teaching, but more rural teachers (29%) than urban teachers (19%) include specifically cultural games.

Despite the frequency and variety of cultural games played in the school communities, few teachers (22%) appear to use them for mathematics teaching and very few appear to use them on a regular basis. Jumping games, observed in communities by 77% of teachers, were used most frequently in the classroom, but only by 9% of the teachers. Stone-passing and pebble-sowing, the games teachers most frequently observed and participated in as children, are currently used in teaching by only a small percentage of teachers (i.e., 6% and 3% respectively).

Teachers in the study were asked, "Do you remember using games for learning mathematics in schools?" More than half (58%) responded "yes," 39% responded "no," and 3% did not respond. Table 6 below shows the proportion of teachers who experienced or did not experience games in school as children and compares it to the number of teachers who currently use or do not use games in their classrooms.

**Table 6: Use of games as a teacher compared to experience of game use in school ($n$ =156)**

| Category | Experienced games | Did not experience games | No response | Total |
|---|---|---|---|---|
| Non-users | (30) 19%<br>(8 Rural, 22 Urban) | (51) 33% | (1) % | (82) 53% |
| Users | (61) 39%<br>(17 Rural, 44 Urban) | (10) 6% | (3) 2% | (74) 47% |
| Totals | (91) 58% | (61) 39% | (4) 3% | (156) 100% |

Table 6 reveals some interesting comparisons between experiencing games as children in school and using games as a teacher. Although the split between users and non-users is approximately equal, of the 74 teachers who use games, 61 of them (82%) reported experiencing games as children in mathematics classrooms. Of the 82 teachers who do not use games, 51 teachers (62%) did not experience games as children. There is a relationship between experiencing games as a child in the classroom and using games as a teacher, although we cannot state that this is a causal relationship. For example, it is possible that those using games were simply more likely to remember experiencing games in the classroom as children. Teachers who use games may be more attuned to or interested in playing games.

Another question from the survey asked teachers to declare whether they experienced games in primary, secondary and/or college (i.e., teacher preparation). Table 7 shows the grade levels at which teachers experienced the use of games. The percentage indicates the proportion of teachers who experienced the use of games at each level.

**Table 7: Levels teachers experienced games in mathematics in school (*n*=152)**

| Grade Levels | Primary (6-11) | Secondary (12+) | College (16+) | Unspecified | Total | No experience |
|---|---|---|---|---|---|---|
| Percentage (# ) % | (82) 54% | (3) 2% | (5) 3% | (4) 3% | (94) 62% | (61) 40% |

(Note: one teacher experienced games at both primary and college levels while one experienced games at all levels: i.e. 2% overlap)

The data reveals that 54% of these primary school teachers remembered playing games as children in their primary school mathematics classroom. Only a very small proportion of teachers experienced the use of games in secondary (2%) and at the college level (3%) where mathematics teaching or mathematics methodology is taught.

In 1987 games were specifically identified to be used to teach in the primary mathematics curriculum. Prior to 1987, there was no expectation that games were to be included in the mathematics classroom; yet, 54% of teachers remember playing some form of game. Most of the teachers in the survey received their teacher training after 1987, but the results suggest that games were not addressed in their teacher education programs. Also, the fact that only 47% of teachers currently use games and only 22% use cultural games, suggests that the inclusion of games in the curriculum made no change to the number of teachers actually using games in classrooms today.

## Teachers' Perspectives of the Purpose for Playing Games in the Community

On the questionnaire, teachers were asked, "what do you think is the purpose of playing games in the community?" In analyzing teachers' open-ended responses on the purpose of games in their communities, I considered the societal, cultural, and social interpretations of their responses. This analytical frame illustrated in Table 8 revealed six perspectives about the purpose of playing games within their communities including

social interaction, motivation, cognitive development, moral development, cultural knowledge acquisition, and physical development.

**Table 8: Perspectives on the purpose of playing cultural games in the community ($n$=154)**

| Purpose | Percentage (%) |
|---|---|
| Social interaction:<br>• making friends<br>• building relationships<br>• developing team spirit and unity in groupwork<br>• creating avenues for interactions | 65 |
| Motivation:<br>• easing boredom<br>• arousing interest<br>• providing recreation<br>• giving pleasure<br>• stimulating interest to participate | 51 |
| Cognitive development:<br>• Cognitive capacity (23%)<br>➢ developing children's thinking capacity, children's minds, and the learning process<br>➢ developing concepts<br>➢ enhancing understanding<br>• Diversity in learning (5%)<br>➢ exploring ideas<br>➢ learning from others<br>➢ encouraging children to go to school<br>➢ experiencing learning in different ways<br>• Learning skills (7%)<br>➢ communication skills<br>➢ observational skills and alertness<br>➢ reinforcing practice skills<br>➢ independent learning skills<br>➢ problem solving skills | 35 |
| Moral development:<br>• engaging idle hands<br>• promoting honesty<br>• developing leadership roles<br>• diverting attention away from negative to positive attitudes | 25 |
| Cultural knowledge acquisition:<br>• transmitting cultural values<br>• keeping the cultural mathematical heritage alive | 21 |
| Physical development<br>• developing fitness<br>• exercising the body<br>• activating the body | 15 |

The data indicates that 65% of teachers believed that playing games in the community is for socialization. Within the category of *social interaction* teachers stated that games provided opportunities for *"we-feeling"*, cooperation, and interacting with adults and colleagues. Through games children establish and maintain relationships with others within the community.

More than half of the teachers stated that games provided *motivation* and entertainment. Teachers indicated that games were pleasurable, recreational, eased boredom, aroused interest and injected motivation in learning. They stated that games *"entertain the youth in the community."*

The category of *cognitive development* is used to capture views reflecting cultural games as avenues for facilitating cognitive growth. In cognitive development, games are seen as opportunities for developing cognitive capacity, skills, and diversity in learning. Over one-third of the teachers (35%) reported aspects of cognitive development as an important purpose of games in the community. When mentioning cognitive development, teachers said playing games refreshes and develops the mind, and *"makes children's brains sharp"*, *"enhances the capacity to think fast"*, and makes the children *"think deeply."* Through the social process in playing games they stated that mathematical concepts are *"learned unknowingly"* as *"they learn from each other."* In the development of cognitive skills, teachers stated that players develop process skills such as *"observation"*, *"communication"*, *"independent learning"*, *"problem solving"*, and *"reinforcing practice skills"* in the course of play. They also wrote that games develop the child's *"listening skills"*. *Diversity in learning* captures teachers' responses that describe playing cultural games as an opportunity to explore and learn from others,

encouraging others to go to school, and experiencing learning in different ways. Teachers stated that through games *"children follow their friends to school"*, and *"children learn by themselves."*

Twenty-five percent of teachers indicated that a purpose of cultural games is to inculcate *moral development*. Participants stated that moral codes of honesty and leadership roles are learned through community games. For example, one teacher stated, *"Cultural games are generally morally good"* while others felt that games engage the idle hands and divert attention away from negative attitudes. Also, they wrote that games inculcate attitudes and through games they *"learn to obey rules."*

The term *cultural knowledge acquisition* captures teachers' views of playing cultural games as a means to transmit, sustain, and maintain the cultural heritage and knowledge. Teachers stated that games develop and maintain the cultural concepts and skills. Teachers indicated that children learn the culture from games. As stated, games *"serve as a cultural heritage"* and playing them *"helps the youth to learn and know about the culture"*, learn the language *"through utterances"*, and to *"become familiar with their cultural heritage."* Games, as teachers stated, *"uplift the culture"* and *"the tradition goes on."* According to the questionnaires, 21% of the participants see the purpose of playing games as a way of valuing and keeping the cultural heritage alive.

Finally, the term *physical development* describes teachers' views of cultural games that reflect keeping the body fit and in shape. Fifteen percent of teachers stated that games exercise the body physically, mentally, and socially.

According to these six categories, playing cultural games is viewed by teachers as serving multiple purposes and potentially contributing to a child's social, cognitive, moral, cultural, and physical development.

## Pedagogical Advantages and Disadvantages of Games in Teaching Mathematics

When teachers were asked their perspective on the advantages of games in teaching mathematics, their open-ended responses showed a range of opinions. The range is organized according to users' and non-users' views about the pedagogical advantages of games in mathematics teaching. Three of the categories identified under purposes were common to the advantages stated by teachers including: *cognitive development, social interaction,* and *motivation.* A fourth theme emerged and was grouped under the category, *games as a teaching strategy.* Table 9 illustrates these four categories. The percentage indicates the number of teachers who view games as having that advantage.

**Table 9: Teachers' perspectives of the advantages of using games in teaching mathematics (*n*=147)**

| Foundational Categories | Users (n = 71) (#) % | Non-users (n = 76) (#) % | Total (n = 147) (#) % |
|---|---|---|---|
| Cognitive development | (51) *72%* | (62) *82%* | (113) *77%* |
| · Promotes understanding and connections | (26) *37%* | (36) *47%* | |
| · Makes mathematics practical and less abstract | (15) *21%* | (27) *36%* | |
| · Aids retention and remembrance | (9) *13%* | (7) *9%* | |
| · Provides the basis for conceptual building and thinking | (6) *9%* | (6) *8%* | |
| · Develops skills (e.g., critical and logical, and problem solving skills etc.) | (4) *6%* | (12) *16%* | |
| · Eases continuity of learning | (3) *4%* | (1) *1%* | |
| · Enhances learning transfer | -- | (1) *1%* | |
| · Develops mental and physical abilities | (1) *1%* | (1) *1%* | |
| · Promotes learning unknowingly | -- | (4) *5%* | |
| Social interaction | (54) *76%* | (35) *46%* | (89) *61%* |
| · Increases participation with interest | (34) *48%* | (26) *34%* | |
| · Promotes interaction/groupwork/team spirit | (21) *21%* | (4) *5%* | |
| · Increases attention and level of concentration | (6) *9%* | (6) *8%* | |
| · Engages all senses in learning | (3) *4%* | (1) *1%* | |
| · Develops competitive spirit | (1) *1%* | -- | |
| · Provides easy access | (1) *1%* | -- | |
| Motivational | (37) *52%* | (47) *62%* | (84) *57%* |
| · Arouses, sustains and makes the lesson and subject interesting | (34) *48%* | (48) *63* | |
| · Re-enforces or motivates learning | (5) *7%* | -- | |
| · Develops confidence in students | -- | (2) *3%* | |
| · Eliminates fear of mathematics | (2) *3%* | -- | |
| An alternative teaching strategy | (18) 25% | (22) 29% | (40) *27%* |
| · Makes teaching easy, less tiring | (14) *20%* | (21) *28%* | |
| · Promotes explorations | (3) *4%* | -- | |
| · Provides an alternative method to the teacher | (1) *1%* | (1) *1%* | |
| · Makes lessons child-centered | - | (1) *1%* | |

The most common advantage of games in mathematics, stated by 77% of teachers, was related to improving *cognitive development* in mathematics. Teachers expressed views that games provide avenues for children's *cognitive development*. The most

commonly cited views were that games promote understanding and connections and make mathematics practical and less abstract. Teachers also stated that games aid retention and remembrance and increase attention and level of concentration. Teachers viewed games as a means for developing concepts and skills consciously and unconsciously. In particular, they wrote that games develop skills in critical and logical thinking, problem solving, and mental mathematics. A number of teachers felt that games ease and allow for continuity in learning mathematics. Surprisingly, more non-users (82%) than users (72%) felt that games contributed to children's cognitive development; this was especially apparent in the sub-categories of making mathematics practical, promoting understanding, and developing skills.

The second most frequently stated advantage involved enhanced *social interaction.* Sixty percent of teachers mentioned that games increased learner participation and interest most frequently, followed by the view that games promote interaction, group work and team spirit. Within this category, teachers also mentioned that games increase children's attention and concentration in the learning process, instill the desire to win as learning becomes competitive, engage all senses interacting in learning to enable the child to make connections, and allow easy access to the cultural games. The largest difference between the views of users and non-users of games occurred in the category of social interaction. Seventy six percent (76%) of users cited social interaction as an advantage while only 46% of non-users recorded aspects of interaction as an advantage. Also, in all sub-categories under social interaction, more users reported social interaction as an advantage over non-users. This result suggests that non-users are either not aware

of these advantages or perhaps they did not view social interaction as an advantage in the learning of mathematics.

More than half of the teachers' (57%) viewed games as a *motivational* way to engage in mathematics. They stated that games reinforce and motivate learning in their ability to arouse, sustain and make the lesson and subject interesting. Also, some teachers stated that games eliminate fear of mathematics and develop confidence in children. Slightly more non-users (62%) than users (52%) indicated motivational aspects of using games in the classroom.

Finally, 27% of teachers' indicated that there were advantages inherent for using *games as a teaching strategy*. Games provide an alternative approach for the teacher, provide opportunities for the learners to engage in mathematical explorations, and make lessons child-centered. The proportion of users (25%) and non-users (29%) who cited this aspect as an advantage are similar; however, more non-users believed that including games makes teaching easy and less tiring.

Ironically, in all areas except social interaction, more non-users noted advantages to games as an educational tool compared to the users. Although non-users appeared to identify more advantages to using games compared to users, this data does not suggest why they chose not to incorporate the use of games. The next question, "What are the disadvantages or challenges of using games in teaching mathematics?" provides some insight.

The responses to the open-ended question on the disadvantages or challenges of using games in teaching mathematics were grouped according to the same four categories but in a different order according to frequency: games as a teaching strategy;

social interaction; motivational attributes and cognitive development. The categories and sub-categories illustrating both user and non-user responses are shown in Table 10. The percentage expresses the proportion of teachers who reported these sentiments in the open-ended question.

**Table 10: Teachers' perspectives of the disadvantages of using games in teaching mathematics (*n* = 140)**

| Disadvantages | Users (n = 67) (#) % | Non-users (n = 73) (#) % | Total (n = 140) (#) % |
|---|---|---|---|
| Games as a teaching strategy | (46) *68%* | (44) *60%* | 90 *(64%)* |
| · Involves a lot of time and a lot of work | (32) *48%* | (42) *56%* | (74) *53%* |
| · Managing large class is problematic | (21) *31%* | (18) *25%* | (39) *28%* |
| · Difficult in accessing and inadequacy of materials | (20) *30%* | (10) *14%* | (30) *21%* |
| · May be used as an excuse to avoid teaching | (2) *3%* | (2) *3%* | (4) *3%* |
| · Assessment difficulty | (1) *2%* | -- | (1) *<1%* |
| · Selecting game is difficult | -- | (1) *1%* | (1) *<1 %* |
| Social interaction | (21) *31%* | (16) *22%* | (37) *26%* |
| · May cause conflicts and fights | (9) *13%* | (2) *3%* | (11) *8%* |
| · Students tired after playing activities | (6) *9%* | (5) *7%* | (11) *8%* |
| · Generates a lot of noise | (6) *9%* | (5) *7%* | (11) *8%* |
| · Makes student's hands and clothes dirty | (5) *8%* | (5) *7%* | (10) *7%* |
| · Students may turn lesson into play | (5) *8%* | -- | (5) *4%* |
| Cognitive development | (4) *6%* | (10) *14%* | (14) *10%* |
| · Results in dependency on games | (2) *3%* | (9) *12%* | (11) *8%* |
| · Game phobic students/ introverts may learn nothing | (2) *3%* | (2) *3%* | (4) *3%* |
| Motivational Attributes | (6) *9%* | (4) *6%* | (10) *7%* |
| · Diverts attention | (3) *5%* | (4) *6%* | (7) *5%* |
| · Induces laziness among some students and teachers | (3) *5%* | -- | (3) *2%* |

Table 10 shows that more than half of the teachers (63%) reported that using *games as a teaching strategy* had some inherent disadvantages. The time and effort (53%), classroom management (28%) and material access (21%) were the most commonly cited disadvantages. Both users (68%) and non-users (60%) reported that using games as a teaching strategy posed significant challenges. Interestingly, slightly more non-users (56%) reported the time and effort to use games as a teaching strategy as a difficulty or challenge than the actual users of games (48%). On the other hand, 31% of the users stated that game-based practice increased their managerial problems such as class organization, control, and supervision in large classes whereas only 25% of non-users reported these concerns. Also, 30% of the users stated difficulty in accessing and inadequate materials while only 14% of non-users indicated this challenge.

Approximately one-quarter (26%) of the teachers stated that the *social interaction* of games has the potential to be a distraction to the learning process through the noise generated, conflicts that might result, and the potential health risk to children in making their hands and clothes dirty. In all categories, users reported concerns related to social interaction more frequently than non-users.

Only 10% of the teachers stated disadvantages related to the *cognitive development* category. Both users and non-users stated the use of games in mathematics teaching can induce dependency on games and some commented that extroverts may usurp the game activities such that game phobic students or introverts may not have equal opportunities to learn. Children who depend on the games will not learn or consider the class boring when there are no games.

A small percentage of teachers (7%) indicated some *motivational attributes* as a hindrance to learning mathematics. In particular, teachers stated that games divert attention and induce laziness among teachers and students in the teaching and learning process. Some teachers may engage children with games and then *"do their own thing."* Children may also enjoy games to such an extent that they do not feel motivated to learn any other way.

Using similar categories for game purpose and advantages and disadvantages of games allows some comparisons to be made. The category of social interaction was prominent in all three categories. While 65% of teachers viewed socialization as the purpose for in the community, 61% also saw aspects of social interaction (e.g., increased participation and teamwork) as one of its greatest advantages (particularly by game users). However, both users and non-users identified concerns related to game play in the classroom. When choosing to implement games, teachers must weigh the pros and cons of this approach. For example, although games increase participation, they also generate a lot of noise; and although games help develop friendships, they can also create conflict or turn into play.

Recall that most teachers view cognitive development as the greatest advantage of using games (77%) but fewer teachers (35%) viewed enhanced cognitive development as one of the purposes of games and a handful of teachers (10%) also noted that games may be detrimental to cognitive development.

Another interesting contrast occurs when teachers consider games as a teaching strategy. Twenty-seven percent of teachers identified positive aspects of using games to teach and to learn, but many (60%) also viewed it as a major challenge due to the extra

time, effort and management problems created. Comparing advantages and disadvantages suggests that some teachers may feel that the disadvantages for using games as a teaching strategy outweigh possible advantages.

## Relationship between School Mathematics and Cultural Games

A teacher considering implementing games in the classroom would certainly need to weigh the possible advantages and disadvantages; however, another important factor to consider is the actual mathematical content that might be learned through the playing of games. What cultural games can teach depends on teachers' awareness of the mathematical relationships between the games and the school mathematics curriculum. To gain insight into teachers' awareness of the relationship between cultural games and school mathematics, participants were asked: "Do you think cultural games relate to school mathematics? If so, in what ways?"

A total of 136 (96%) of the 141 teachers who responded to the question indicated there was a relationship between cultural games and school mathematics content. Only five teachers (4%) saw no relationship between cultural games and mathematics. Of the 136 teachers who responded positively, 131 teachers (93%) indicated ways in which games address mathematics content while only five participants (4%) did not. Interestingly, 50% of both users and non-users noted at least one relationship between a game and mathematics content. Table 11 reports the relationships teachers saw between school mathematics content and categories of cultural games. The percentages of teachers who identified those relationships are also indicated.

**Table 11: Cultural games identified by teachers and their relationship to mathematics (*n* =136)**

| Mathematics Content | Game classification and ways of relationship | Users (n = 74) (#) % | Non-users (n=82) (#) % | Percentage (%) |
|---|---|---|---|---|
| Number and number operations concepts | Playing hopping, jumping, stone-passing/-throwing, pebble-/marble-pushing and pebble-sowing games involve number, counting, basic arithmetic, and pre-number activities in obtaining materials. | (54) 82% | (47) 72% | (101) 77% |
| Measurement | Pebble-pushing and comparing games. Constructing and playing pebble- rolling and hopping games involve measuring and drawings playing comparing games involve comparing capacities. | (10) 15% | (16) 25% | (26) 20% |
| Shapes and space | Construction of pebble-pushing, some hopping games and patterns of play in most of the games involve plane geometry. Dancing games involve movement geometry; hopping, pebble-pushing/-rolling and marble-pushing games involve constructions. | (7) 11% | (7) 11% | (14) 11% |
| Problem solving and investigations | Games involve observing, logical thinking and reasoning. All pebble sowing games involve sorting, counting; playing all games involve strategies, and communication. All games contain some mathematics skills; Counting, measuring, sorting, reasoning, constructing, etc. Games involve rules as in algebra. | (6) 9% | (5) 8% | (11) 8% |
| Collecting and handling data | Games involve probability. Hopping games involve collecting data. | (4) 6% | (3) 5% | (7) 5% |

The data in Table 11 indicates that on the whole teachers found all cultural games in their communities relate in some way to school mathematics. Of the teachers who were able to identify mathematics in cultural games, most (77%) stated that cultural games involve number concepts and number operations. Other content was mentioned, but much less frequently including: measurement (20%), shapes and space (11%), problem solving and investigation (8%) and collecting and handling data (5%). In all categories, there is only a slight or no disparity between users' and non-users' awareness of the relationships between cultural games and school mathematics.

The classification of cultural games in their areas of mathematical relationships as in Table 11 and teachers' statements to the open-ended question "Do you think cultural games relate to school mathematics? If so, in what ways?" indicated that most users and non-users believe cultural games relate to school mathematics in three main ways: in *play*, in *construction*, and in *searching for materials*. Teachers' examples of how they relate to the process of play, construction, and searching for materials are as follows:

(a) *The playing process:* In playing hopping games (*dansu/dããsu*) players count the number of times they win or lose and to add or subtract. *"'Baa-baa' relates to measurements and numeracy ... 'iri maa yi' relates to order of numerals and subtraction."* The player measures and draws lines when he or she wins. Also, *"when we take one of the games, for example hide and seek, marks are accumulated. The first person to find the treasure is given 100, 2nd 90, 3rd 80 and so on. These marks are added together and the person with the highest mark wins."* Similarly when playing the jumping game *(ampe)*, marks are scored. One has to keep track of the score for the first round and add scores received in the subsequent rounds. *"Cultural games introduce the*

*pupils to measurements in filling the bottle, 'boŋsiŋãã',* [a comparing game]." As they play, they count and others record the marks.

(b) *The construction process:* In the process of "constructing" hopping games (*dansu/dããsu*) students make rectangles/squares; in the pebble-sowing game *(daha)* they dig arrays of holes; while in the pebble-pushing game (*baa-baa*) students draw lines and shapes. *"Constructing the game may involve drawing lines, measuring, sorting, and counting as in mathematics."*

(c) *The searching process:* Materials have to be obtained for playing most of the games especially the pebble-sowing/-pushing games. Getting some game materials may *"involve sorting, matching, ordering, and comparing as in early number work."* In the pebble-sowing game, *daha*, you sort and count the seeds, stones, and holes. All these processes involve the use of *"mathematical language, observation* [and] *mathematics thinking"* as in school mathematics. Simply put *"cultural games provide a basis for mathematics learning. Most games are problem solving oriented, follow a pattern, and have rules. So it is mathematics."*

The evidence that teachers gave about the mathematical content of specific cultural games and their relationship to school mathematics suggest some awareness of the mathematics in cultural games.

## Discussion

The participants' responses to the questionnaire provide a broad picture of the primary school teachers' experiences and perspectives in the use of games in the mathematics classroom. Through descriptive data analysis the survey reveals information regarding Ghanaian primary teachers past experiences with cultural games in their own communities and in their education from primary levels to college, their use and non-use of games in the mathematics classroom, their perceptions of the purposes of cultural games in their communities, the advantages and disadvantages of games, and their awareness of the mathematics content within games.

All teachers in the study were familiar with at least one type of cultural game and most, particularly those raised in rural communities, have experienced and have a broad familiarity with a wide range of cultural games in their communities during childhood and adulthood. The types of games experienced during teachers' childhoods are similar to those experienced by children in contemporary Ghanaian communities, although there appears to be a significant decline in engagement in games. There was some overlap in the popular games of yesterday and today, for example jumping, hopping, and stone passing/throwing games. The popularity of these games may be due to their simplicity. As simple games, they can easily be learned. However, the prevailing decline in participation, such as games in songs, may signal the impending death of an important aspect of the Ghanaian heritage.

The questionnaire revealed that just less than half of the teachers reported using games in the mathematics classrooms and only a small proportion of teachers appear to use games as a regular pedagogical strategy. Although more urban teachers tend to use

games, rural teachers, perhaps drawing on the higher participation rates and variety in these settings, use cultural games more often in their mathematics teaching.

Even though games were not specifically identified in the mathematics curriculum when some of these teachers were students in primary school, more than half of the teachers remembered experiences of using games in learning mathematics. Today, the use of games is an expectation within primary school mathematics teaching, yet only half of teachers report using them. Since few teachers experienced games at teachers' college, these teachers may not have an awareness of games within the curriculum and, even if they did, they would not have methods or models on which to draw. Dewey's (1938) idea of direct experience as central in educational practice is relevant here. Teachers who remembered games from their own learning experiences appeared more likely to incorporate games into their own classrooms as teachers.

Examination of the teachers' perspectives of the purpose of playing games and the advantages and disadvantages of using games in the mathematics classroom revealed some interesting contrasts. Social interaction, motivational attributes and cognitive development statements were made with reference to the purpose of games in the community and with both the associated advantages and disadvantages of using games in the classroom.

Social interaction aspects featured prominently as a component of the purposes, advantages and disadvantages of games. It is the positive aspects of games as play and entertainment that also can be viewed as a concern when the focus of school mathematics is for learning. This seemed particularly true for current non-users of games. In contrast to users, non-users either were not aware of the social interaction advantages within a

classroom setting, or possibly, given the autocratic nature and overcrowding in many primary classrooms, they could not envision socialization contributing to mathematics learning. The disadvantages listed such as the increased noise level and the potential for conflict point to concerns held by both users and non-users.

Another contrast occurred in the perspectives on games as a teaching strategy. While some users and non-users indicated the advantageous aspects of using games as an alternative practice, a much larger proportion of participants commented on the extra time, effort and management problems created when games are used in teaching mathematics. Comparing advantages and disadvantages suggests that some teachers may feel that the disadvantages for using games as a teaching strategy outweigh possible advantages.

One could argue that teachers are simply not aware of the mathematics in games and, as a result, do not consider them valuable for learning mathematics; however, almost every teacher in the study could identify at least one relationship between cultural games in the community and school mathematics content. This result provides further evidence that there is a difference between knowing what and knowing how. Thus, it "is not just what mathematics teachers know, but how they know it and what they are able to mobilize mathematically in the course of teaching" that can provides a foundation for pedagogical action in craft practice (Ball & Bass, 2000, p. 95). Conceptual awareness is not a substitute for pedagogical awareness. This is also supported by the teachers' perspectives on the disadvantages of games in the classroom.

Another set of contrasts occur when we consider differences in the perceived purposes of games as they are played in the community and their role in the classroom.

Although cognitive development was seen as the most common advantage of games in the classroom, significantly fewer teachers recognized learning as one of the primary purposes of games as they are played in the community. Perhaps many teachers have difficulty reconciling the purpose of games as they see them in the community and the potential for learning that games offer.

Another unfortunate contrast is that while some teachers did note that cultural games are important for the purpose of sharing culture and traditional knowledge and values with children, this valuable purpose was not mentioned as an advantage. If the intention for the inclusion of games in the curriculum was to emphasize indigenous knowledge and to improve the relevance of mathematics by connecting with the lives of children outside of schools, then this purpose or advantage has not been recognized by primary school teachers.

In sum, the results of the survey of teachers' background experiences on game-based pedagogy as presented and discussed in this chapter indicate that teachers have the opportunity to experience cultural games as part of their cultural life in their communities and that concepts, skills, and processes are conceptualized in cultural games. The data informs that although teachers indicated many advantages to using games in mathematics, only few could translate them into practice. Clearly, there is more than content knowledge, conceptions, and beliefs in implementing practice.

The ultimate goal of my study was to understand the realities of cultural game pedagogy among primary school teachers. In this chapter, I shared the results of the questionnaires. In the next chapter, I present the interpretive results of the interviews.

# CHAPTER V

# THE INTERVIEWS

In this chapter, I examine teachers' experiences and perspectives regarding the use of common and cultural games in the mathematics classroom through an analysis of the data collected through the in-depth informal conversational interviews (IDICIs).

## Participants

In addition to completing the questionnaire, teachers were also asked whether they would be willing to participate in two one-on-one interviews. Of the 156 who completed questionnaires, 29 teachers indicated that they were willing to be interviewed. Ten teachers were selected (see Table 2, Chapter III). My choices were based on experience, location, gender, and use and non-use of games. Of the ten participants, seven indicated that they used games, three did not; six were teaching in urban centers and four were in rural areas; eight were female and two were male. Teachers ranged in experience from 4 years to 30 years and the range of current teaching included Primary 1, 2, 3, and 5. A brief description of the participants in each category is as follows:

### *Game users*

Martha is a primary class two teacher with 50 pupils. In her 17 years of teaching experience, she has taught at both the lower and upper primary levels. She played many cultural games when she was young. Her use of cultural games for mathematics teaching stems from her belief that using games will make mathematics learning easy. She uses both cultural and common games as resource materials for teaching mathematics.

Edith is a primary class two teacher with 82 pupils. In a classroom meant for about 46 pupils, there is limited space for the pupils and the teacher to move around. In her 20 years teaching, she taught at both the lower and upper primary levels. She was introduced to the use of games in mathematics teaching through an In-Service Education and Training (INSET) program that provided the foundation for personal initiatives on the use of cultural games.

Of the interviewees, Jane has been teaching the longest with 30 years experience. She has taught across all levels of primary school. She teaches primary class three with 44 pupils. She had experienced cultural games in both rural and urban settings in her early years and developed a special interest in them. She strives to use cultural games in her mathematics teaching.

Gevase, with only four years of teaching experience, teaches a primary class five with 49 students. He had observed the use of dominoes and bingo games in mathematics teaching during his pre-service professional development and developed an interest in cultural games.

Selina is a primary class five teacher with 50 pupils who has been teaching in the primary school for the past 15 years. In her teaching experience, she has taught at both the lower and upper primary levels including class two, three, and five. She has a rich experience with games from many cultures. She recognized the mathematics inherent in cultural games after attending college. She uses both cultural and common games for mathematics instruction.

Paul is a primary class one teacher with 60 pupils. In his six years of teaching, he has taught at both the lower and upper primary levels. His awareness of the use of games

occurred through an intervention workshop programs initiated by an NGO to improve teachers' professional practice in very remote communities in his district. Following the workshops, Paul explored the use of many cultural games in mathematics teaching.

Vero, a primary class one teacher also acted as a member of an in-service team for the professional development of primary school teachers. Although she never learned the pedagogy of mathematics education at college, her interest in mathematics teaching motivated her to learn how to teach the subject on her own. She has 20 years teaching experience and has taught at both lower and upper levels of the primary school. She identifies the mathematics of cultural games as she plays them but uses only common games for her mathematics teaching.

*Non-users*

Ruth teaches a primary class two with 48 pupils. She played many games when she was young. She has taught across primary class one to four in her 15 years teaching experience. She is aware that games in teaching mathematics make mathematics learning interesting; however, she has never used a game as a resource for mathematics to motivate children. Rather, she tries to motivate children through giving stories and story problems.

Among the non-users, Vida has the least teaching experience with five years. She teaches class two with 34 pupils. She played many games during childhood. Although she is aware that there is some mathematics in common games as exemplified in the curriculum resource materials, she has never thought about the mathematics in cultural

games. Her awareness of the mathematics of cultural games was only through her participation in this research. She has never used any game in teaching mathematics.

Doris teaches a primary class three with 82 pupils. She played many games when she was young. Although she knows that *"games help children to learn mathematics"* she does not *"know of any traditional game to use in teaching mathematics."* As such, she has never used a game in teaching mathematics in her 19 years of teaching experience. She has taught across all levels of the primary school (class one to six)

## Games in the Curriculum: Teachers Conceptions, Awareness, and Experiences

Findings in Chapter IV indicate that 151 participants had some experience observing and playing cultural games in their communities. In this section, I examine the participants' conception of a game, their awareness and use of cultural games in the curriculum, their professional development experience towards the use of games in teaching mathematics and their perspectives on the advantages and disadvantages of using cultural games in the mathematics classroom.

### *Conception of a game*

Ghanaian curriculum developers might have assumed that a game is an everyday concept that should be known and understood by practicing teachers. However, early in the interview process, I realized that the participants appeared to have very different perspectives as to what constitutes a game.

When asked, "What is a game?" Gevase said, *"A game is just a competition where a winner is declared and there are always rules and regulations governing everything.*

*So it is an organized competition whereby a winner is declared."* He believes that an activity *"where there are no winners ...is not a game."* He is consistent with his concept believing that games have predetermined rules and are competitive with winners and losers. This perspective would exclude cultural activities such as *aŋlee* and *koore* in the list of cultural games.

Similarly, Martha also focused on competition and rules and said, *"You compete amongst yourselves. The rules. The rules make a play to be a game."* However, on her list of cultural games from the questionnaire, she had included *aŋlee* and *koore*. When questioned about the inclusion of *aŋlee* and *koore* she said, *"Any activity that is competitive is a game. But the aŋlee and the koore I don't think they should be games because they are just to warm up the body. There is no winner."*

Vero's perspective also included competition and rules. In the first interview with her, she said that a game was,

> *an activity that entails a rule or rules that is played by a pair or a group of people and it has losers and winners. When you have losers and winners, then it becomes a game, otherwise it stands to be an activity.*

However, she too had listed *aŋlee* as a game on her completed questionnaire. In the second interview I asked, *"Why would you consider aŋlee a game?"* Vero replied, *"It is a game because it is used for pleasure and entertainment, for leisure. There is a format. They just don't jump around. It is organized."* I questioned her original definition of a game and asked if she wanted to modify it. She responded, an *"activity is a game if it gives pleasure, entertains, has format, and organized. Winning or losing become part of*

*the rules."* Vero's modification maintains that games require rules; winning and losing may become explicit rules of a game, but this component is not a requirement.

Jane, a seasoned teacher, conceptualised games very differently by stating that *"A game is a practical activity that you enjoy. It is something that builds your mind, your memory, your sight, and all that."* This conception of a game makes no mention of rules and competition. Rather it focuses on cognitive and physical development.

Vida, a non-user of games, first conceptualised a game as *"something like a play. You have to involve children and yourself. You all take part in the activity. At the end of it all the children should understand what you are trying to let them know."* Further probes led to a revised version of game as a *"play that involves children, including yourself, like using objects to manipulate having an objective."* Her view of game doesn't directly imply rules or competition; instead it focuses on play and materials. I was uncertain about Vida's emphasis on materials and asked her what the objects were for *ampe*, the jumping activity. She said, *"For that there are no objects. We use our hands and legs."* I asked whether it could still be considered a game if it did not have objects and she maintained, *"It's a game."*

Ruth, a veteran teacher, provided her description of a game as:

> *I will say a game is when all children participate in singing or clapping or doing exercises* [activities]. *I will consider it to be a game if you ask children to do something and together they do it in a group. I think it is a game. If they run around and sing around and say some words, is it not a game? It is a game. To me it is a game. The activities that they do, I will call it a game.*

Ruth's view contradicts those participants who emphasize the importance of competition and rules. In fact, she places the singing and dancing activities at the centre of her definition and emphasizes the cooperative nature of games. Her uncertainty of how to define a game is apparent in the following dialogue (R = the researcher and Ru = the teacher).

*R:* *From what you have said it seems you are using games – clapping hands are all forms of games. Why then, do you say you don't use games?*

*Ru:* *I don't normally call them games.*

*R:* *Why don't you call them games?*

*Ru:* *Because they don't use any materials.*

*R:* *Must a game involve materials?*

*Ru:* *Of course, some games involve materials, but not all.*

*R:* *Do you know, we have singing games as well. So it means that invariably you use games without knowing. We have singing games, clapping games, etc.*

*Ru:* *Yes, I use them but I don't know they are games. Then it means I use them without knowing, just to motivate the children.*

While the curriculum states that games are to be used to develop mathematical concepts, it does not define what a game is or provide a definition or description of a game. From the perspectives shared above, some participants appeared to insist that games involve a competitive element, while others suggest they do not; some interviewees stated that rules are required, while others suggested that anytime children are playing it can be considered a game; a few participants believed that materials are necessary for an activity to be considered a game and others did not feel this was a

requirement. Although on the questionnaire, teachers self selected whether they were game users or not, the discussion above suggests that each person may have used a different definition for determining whether or not he/she used games in teaching mathematics.

A further difficulty in defining games, is classifying which ones are cultural and which ones are not. Selina expressed uncertainty regarding this issue in the following dialogue:

*R:* *Can you tell me the traditional games you played when you were a child?*

*S:* *We play ampe. Ampe is not a traditional game but most of the time we played ampe.*

*R:* *Ampe is not a traditional game?*

*S:* *Umm. Or what do you say?*

*R:* *I don't know much about that game.*

*S:* *I also don't know it. When we were growing up, it was there....*

*R:* *But this one (baa-baa), is it a traditional game?*

*S:* *Yes, but the ampe I'm not sure. Because if you go down South they still play this game. But this baa-baa I'm talking about...it is only our community here they play it. I have travelled outside. I have never seen people doing this.*

*R:* *What about daha?*

*S:* *Yes, it is a traditional game. Other people have learnt it but in the form of damme* [draughts]. *It is not like ours. We dig holes in the ground.*

Selina's general definition of a cultural game emphasizes only those games played solely within her community. However, her uncertainty suggests further problems with how

teachers might interpret which games are appropriate for inclusion in the mathematics classroom.

### *Awareness of games in the curriculum*

Since the curriculum does not define the term "game" nor provide explicit information on the description of games or the types of games to use, another question I posed to the teachers was simply whether they were aware of the inclusion of games in the curriculum.

When I asked Paul if there was a statement in the curriculum about the use of games, he was able to recite the curriculum content most clearly:

> *Yeah. There is a statement like that. The curriculum says teachers should use games to teach mathematics. It encourages teachers to use or develop games to teach mathematics in schools. I have seen a statement like that. The quotation is not exactly what I am saying, but there is at least a statement like that.*

When asked, almost every participant said 'yes', they were aware that the curriculum mentioned games. Only Jane, a current user of games, said *"I have not seen anything like that."* But then qualified her statement by saying, *"But sometimes when you read, and you go through the curriculum you see something like that but not deep into it. It's just mentioned."*

While most participants were aware of the inclusion of games in the curriculum, there were divergent perspectives as to whether teachers are required to include games. Paul said, *"it is rather worrying to see teachers not using games to teach mathematics."* At the opposite extreme, when I asked Doris *"What do you do when it comes to some of*

*the games suggested in the curriculum?"* She responded, *"I don't do anything. I just ignore them."* For Jane, even if a teacher is aware of the use of games and feels somewhat compelled to use them there are barriers: *"Even if you see something like a game and you don't know how to use it, how do you impart it to the children?"* Although most participants appeared to be aware of games as a curricular expectation, they did not all feel it was necessary to incorporate games in their mathematics instruction.

Since most participants seemed to be aware of games in the curriculum, I further questioned their understanding of the type of games expected; in particular, I was interested in their awareness of the intent to include indigenous mathematics through the use of cultural or traditional games.

Again, Paul seemed to be most definitive in his understanding of the curriculum intent. I asked him whether the statement in the curriculum meant that teachers *"should use traditional games or some other games."* He responded:

*P*: *Here the emphasis is on the traditional games. Let's take it that you go and bring a foreign game ... which is not played or which they don't use ... here, or they don't know. They will not be able to develop the sense in it. But the games within the local community, you as a teacher should go out and find out what games are they playing?*

*R*: *So, to you ... the use of games means the use of traditional games?*

*P*: *Yeah, the use of traditional games. Not any other game from any other part of this world.*

However, none of the other participants had formed such a definitive view. Jane stated that she became aware of the importance of games, *"around 1990's onwards."*

But said, *"We didn't even know whether they were traditional or not. We, as at that time were not abreast as at now. We didn't even know the importance of using games for teaching."*

Similarly, when I asked Gevase about his awareness of games in the teacher education syllabus, he responded, *"Yes. I was aware, but not traditional ones."* In fact, his college tutors, *"made it very clear that they are not traditional games. .... These are foreign games."* Gevase's comment regarding his own teacher training is a further area that I explored in the interviews. I assumed that the teachers' experiences with games in their teacher training and through in-service experiences would all have an impact on their awareness and use of games in the teaching of mathematics.

### *Experiences with games: professional development*

The pre-service and in-service professional development a teacher experiences influences what happens in his or her classroom. Since participants were aware of games in the mathematics curriculum, I was interested in learning how they experienced the use of cultural games as an instructional tool in their professional development; first, in their teacher education and second, in their in-service sessions.

Throughout the interviews, participants shared their memories regarding the use of cultural games during their teacher education. Several teachers with many years of experience had difficulty remembering whether they had experienced games or not. Neither Edith nor Doris, both with approximately twenty years' experience, could remember using games in their pre-service education. Jane, who has thirty years' experience, likely never received professional training as games were not in the syllabus

at that time. For other teachers who could remember, the common response was that their experiences were limited or non-existent. For example, Martha responded:

> *We never had such things really. We met masters and some were even white people* [Europeans].... *The white people were teaching us mathematics and English. ... We never had anybody who was interested in such things* [cultural games]. *We never had any cultural game during mathematics.*

I was especially interested in the comments from Paul, Vida and Gevase all of whom had graduated within the past six years. Paul said, *"I was never taught how to use games at school. I never had any of that experience."* Similarly, Vida commented, *"I never encountered using traditional games anywhere."* Gevase, however, did have some experience. He said, *"I remember one of our tutors who used to use games."* When asked whether they were traditional games, he said,

> *No, not the traditional ones. Like bingo and dominoes and the rest and those things are not traditional games.... I spent three years in college. Nobody has ever taught me how to use these traditional games apart from what I told you and which happen to be foreign games. They are not traditional ones.*

Selina had similar experiences during her preparation for practice teaching. She recounted,

> *We had a teacher who normally uses games—snakes and ladders. He was using it. Even this ludo game he used it to teach data collection. He will let children play. He will write 1, 2, and 3, up to 6. Then the number of people who play 6 will be reflecting the frequency, then those who play 4. After that you will see the grade and plot as data. You will even draw a graph through that.*

Similarly, Ruth remembered that *"Back at the college* [their] *mathematics tutor used to teach* [them] *mathematical games. In fact, we also tried to do something using it."* However when asked whether cultural games were used, her response was emphatic: *"No. He did not use any games from the locality."*

From the teachers' responses it appears that few teachers experienced or remembered experiencing the use of games to teach mathematics. Of the participants that did remember the use of games, the games they had observed—snakes and ladders, bingo, dominoes, and ludo—were common.

In-service training programs provide additional opportunities to understand the implementation of games in the curriculum. I explored further what in-service opportunities participants received on the use of cultural games. I found similar responses amongst the participants. Most teachers had not received or did not recall receiving any in-service training on the use of games to teach mathematics. Only Edith and Paul stated that they experienced the use of games through in-service programs.

Edith, who currently uses cultural games to teach mathematics, did not recall any experiences in the use of games in her teacher education. When I asked her how she got the idea to use games, she said it was through In-Service Education and Training (INSET); however, when I asked whether the focus was on cultural or foreign games, she responded *"it was foreign games"* that were used.

Paul did not receive training on the use of games during his teacher education either; however he did receive in-service training through the Christian Relief Services (CRS):

> [When] *I completed my training college, I was serving in a deprived community* [and that] *was where CRS came in. CRS is Christian Relief Services. .... They ... gave us a whole lot of workshops, training, and how to upgrade your knowledge level so that you can teach the children well. So it was during the workshops that I learned how to use games. It was just a few of them. ... We were encouraged to use games but as to how to use the games, we were not taught.*

Although the resource persons at CRS encouraged the use of games in general, Paul's inclusion of cultural games in his classroom was based on his own initiative. He said:

> *Sometimes at my own leisure time or when I sit down and look at some people, I try to develop the mathematical sense in it of how that particular game can help me teach the pupils in the community.*

Few participants experienced games during pre-service education and very few experienced their use during in-service opportunities. Of those who shared their experiences with me, the focus appeared to be predominantly on *"foreign"* or more generally, common games, rather than cultural games. All teachers interviewed stated that they did not have the opportunity to learn about the use of cultural games during the pre-service or in-service training.

### Teachers Perspectives of Advantages and Disadvantages of Games in Teaching

In Chapter IV, all participants indicated that they were aware of the use of games in the curriculum and most of them were able to express opinions about the benefits/advantages and concerns/disadvantages of games in mathematics teaching. Using headings similar to those used in the quantitative data analysis namely: cognitive

development, social interaction, alternative teaching strategy, acquisition of cultural knowledge and motivational attributes, I now further examine participants' perspectives on the advantages and disadvantages they hold about the use of games, particularly cultural games, in the teaching and learning of mathematics.

*Cognitive development:*

On the questionnaire (Chapter IV), when participants were asked about the advantages of games in teaching mathematics, the most common response from over three-quarters of the participants was that games promote aspects of cognitive development. The interviews provided a more in-depth understanding of how these participants viewed games as a vehicle for mathematics learning.

Throughout Vero's interview, she repeatedly commented on the value games had for mathematics learning. When asked about the benefit of games in her classroom, she responded:

> *[T]hey build up their mental abilities as they play games. They become very critical, very logical about things. They can argue out things for themselves and find out things for themselves and this can be linked to the outside world not necessarily in the classroom alone.*

Games also, *"help you to unveil certain things that you couldn't have discovered just sitting down looking in a book ... Cultural games in the long run help in consolidating concepts that are taught in schools."* When I asked her if there was anything further she wanted to add, she returned to her perspective on games for learning by concluding that *"games generally add knowledge to children .... Games help in the establishment of*

*concepts. ... So games are usually important to any learning situation especially in mathematics. They will help build-up a lot of situations in learning mathematics."* From Vero's responses we can see a strong emphasis on the value of games for the development of mental abilities such as critical and logical thinking, aiding mathematical explorations, and contributing to and consolidating mathematics knowledge.

Martha also emphasized learning mathematics through games with a description of her own childhood experience using a traditional game, *bombo*:

> *I used to learn* [counting] *from them* [games] *because any time we are playing we count like the bombo. ... When you are counting, you know* [numbers] *verbally but ... you couldn't identify* [a number] *until they say* [in school] *this is the number either one or two or three then they* [will] *write* [it] *and you say ahaa I have been counting but did not know that this was three, this was four and so on.*

When I asked Martha what she liked about using these cultural games in teaching mathematics her response was:

> *They do it themselves. When they do it they understand it more than hearing and seeing. There is a proverb that when they hear, they forget; when they see, they remember; and when they do, they understand.*

Martha strongly believes that cultural games provide children with opportunities to learn mathematics. She, however, indicates that some form of intervention is required to link informal mathematical experience of games to school mathematics for understanding.

Selina also spoke of games as a means to learn mathematics. In particular, she described *baabaa* as a game for *"the starting of learning to measure lengths."* When I asked her directly if the children can learn the mathematics in the game without her

presence, she responded: *"As for that, when they go home they do it in their homes. Am I there? I am not there but because they enjoy it, they do it in their houses and they learn more concepts."* While initially it appeared as though she believed the children could learn the concepts directly by playing, when I asked how her children make connection between the mathematics in the game and the school mathematics she is teaching, she said:

> *When you start, you have to tell them it is mathematics period but our topic is measurement. So you have to start with measurement. So they have the idea that they are doing mathematics in addition to the activity they are doing. If you don't tell them, maybe they will think that they are only playing, but if you tell them the reason for doing this, they will have it in mind. They will look and see that they are doing what they are going to do later. They are learning what to do later.*

Gevase also commented on the relationship of mathematics learning and games. When asked about his concerns on the use of traditional games in teaching mathematics he stated that *"the pupils don't know the value of some of these traditional games."* He felt that he needed to *"Let the children know that what they do in their communities they are learning unconsciously."* He also expressed concerns that the games themselves did not explicitly teach the concepts; therefore, after the game *"[t]hen you take them through the theoretical aspects. That is where you will write it on the board and ask them to identify the concepts being introduced."* While Vero appeared to indicate that games could contribute directly to mathematics learning, Gevase appeared to believe that the teacher is needed to make the link explicit through direct teaching. In another comment he stated that *"when you are playing this very game it forces you to think like a*

*mathematician."* However, he said, *"If you don't have knowledge in math or if you don't know when to put or where to put a particular marble at what time, you cannot win."* This comment also appears to contribute to his view that learning mathematics does not occur directly as a result of playing the game, but that mathematical knowledge is needed prior to playing in order for a person to be successful.

Paul also indicated that there wasn't a direct link between the learning that occurred in the game and the mathematics. That is, *"there is a hidden mathematical concept in the local games."* He said that games *"occupy the children during their free period. They just occupy them and once they play the games, they learn some things unexpectedly."* His role as the teacher is to make the link to mathematics explicit: *"After playing the game for some time I bring in the aspect that I want them to learn. Then after teaching them that, you see that they already learn that topic without knowing."* When asked if the children could discover the relationship themselves he responded:

> *No. Children cannot discover it themselves unless you the teacher come in to play a role. You guide them, and then you give them the rules and regulations in the game. So after playing it you relate back to the topic that you ... introduce[d] in the class.*

The five participants above all commented on the influence games have on children's cognitive development in mathematics learning; however, their responses indicated a wide range of beliefs about the value of games for learning mathematics. Vero's comments represent one end of the spectrum in that she believed that children learned mathematical concepts directly as a result of playing games; at the other end, Gevase and Paul indicated that children do not know the inherent mathematical value of

cultural games and, therefore, the teacher must take an active role in helping them make the connection between the mathematics in the games and school mathematics. Since the curriculum does not specify what mathematics is learned through games or how that learning occurs, it is not surprising that teachers expressed a wide range of beliefs about the value of cultural games for mathematics learning. Nonetheless, Vero, Martha, and Selina's comments indicated that children also develop understanding by socially interacting in playing the games.

### *Social interaction*

From the questionnaire, 65% of the participants surveyed indicated social interaction was the primary purpose of cultural games and 61% considered the interactions an important benefit in the mathematics classroom. During the interviews, several participants recalled their own experiences as children learning games in their communities and also the positive and negative social aspects of cultural games in the teaching and learning of mathematics.

Several participants commented on their own experiences learning mathematics. In many instances, they spoke of learning games through other community members. I asked Gevase how a person would learn the games from the community. He responded:

> *First you sit down to observe others playing. Then after they finish playing you also imitate. Something like "bie buiribu" you also take the marbles and play. Even if you are alone, you will take it that your left is for one person and the right for another. Then you put the marbles into the holes and the left and right will play.*

Martha said she learned cultural games *"through my seniors. Those who where ahead of me. They used to play when I was a child. I used to look at them for sometime. Then I also try it myself. Then later on I also* [play with them]." When I asked Vida how she learned to play games from her community she had a similar response:

*Vi:* *I learned to play ampe and bisogi in the school. .... So when we were at the kindergarten and when we go out we see friends will go and take these stones. ... So you watch friends who were matured doing it and you get to know how to do it*

*R:* *So when I observe someone doing something, I should know how to do it?*

*Vi:* *Yah. Through observation you can learn.*

*R:* *So if I observe somebody riding a motor* [cycle], *I can also ride?*

*Vi:* *Yah. You can observe and do it. I observed and got to know how to ride a bicycle when I came here.*

*R:* *But you don't practice?*

*Vi:* *Oh you practice. I observe and practice*

Gevase, Martha and Vida all indicated that cultural games were learned from their peers. The connection between social interaction and learning was mentioned by several participants in their interviews. For example, when I asked Vero what can be learned from the community games that she mentioned, her response was *"In playing games ... they socialize."* Intrigued by her response, I asked, *"In mathematics?"* She explained her reasoning:

> *In mathematics if you can't socialize, you can't do group work—you can't learn in a group. You will be a thorn in the flesh of others. Eha, but if you can socialize,*

*it means you can comport yourself* [i.e., behave well] *and you can learn together. You have that type of cooperative learning nicely together.*

Vero's strong stance on the value of games for learning (noted in the previous section) was strongly connected to her belief that significant learning occurs through social interaction. She further emphasized that *"Games let you share and learn a lot from others, it gives you the desire to be able to win or to lose, to co-operate with others, socialize, get interested and all that."*

Similarly, Selina also thought about the social benefits of cultural games in terms of group learning. After describing a particular cultural game involving measurement, I asked about the benefits of the game to her as a teacher, the children, and the community as a whole. Her response was *"The benefits? OK ... they are group activities so they relate to one another and the community too. The group brings friendship. It brings close relationship to them."* Selina also connected the social aspect of the games with learning when she commented, *"they learn from one another in the group. If you are not able to measure, you will see your friend measuring and you will also stretch your* [hand span] *and measure."*

Both Vero and Selina stressed the social value of cultural games in learning mathematics. In their view, the social nature of cultural games builds positive social relationships and allows children to learn from each other through group work and discussion. Although Vero and Selina saw benefits to the social interaction required in games, they also commented on the negative effects it may have on learning.

When I asked Vero whether children talk in her game-based lesson, her response was *"Yeah. They talk. They communicate. Sometimes* [they] *argue and even to the extent*

*of being very aggressive."* This is where Vero indicated that the teacher has a role in ensuring they play *"fairly"* if the benefit of children learning together through cultural games is to be realized. Vero explained what playing fairly means to her:

> *One may want to dominate the group. ... He wouldn't want to give chance to the others— especially the very bright ones. The bright ones wouldn't allow the slow learner to take part. That you are wasting our time, you will let us lose, so they won't want him to take part in the game. So, the bright ones will always want to monopolize everything. But as a teacher, you go on— give them the instructions. Please give everybody a chance. Give that boy too a chance. Give that girl too a chance. Or else they would side line the girls.*

Selina, referring to the classroom activities in her *baa-baa* measurement game, focused on the nature of discussions and children's reactions to others trying to win by unfair means. She indicated that children *"discuss and even sometimes they will quarrel. When you measure and want to cheat, others will not agree."*

When I asked Vida, a non-user of games in the classroom, whether she had concerns about using cultural games to teach mathematics she indicated another concern: *"if it is ampe, the noise will be disturbing the other classes. ... The noise. You know, no matter how you control them, but as for the noise, the disturbance will come in."*

The views shared by the participants suggest that the social nature of games provide an important avenue for children to learn; however, they may also interfere with learning when disagreements, quarrels, and aggressive behaviours occur, and they may also disturb the learning in other classrooms.

*Games as an alternative teaching strategy*

While approximately two-thirds of the participants surveyed indicated games as an alternative teaching strategy in mathematics as a disadvantage, about a quarter of the participants also saw that strategy as an advantage. During the interviews I examined some aspects of the games as a teaching strategy—time, suitability and accessibility of the games, teachers' awareness and knowledge of the mathematics of the games, conditions for using the games in the classroom (space, health and cleanliness), and possibilities of inappropriate use of the games—for a greater understanding of the advantages and disadvantages of using games in the classroom.

*Time*

Over 50% of the participants surveyed (Chapter IV Table 10) indicated that 'time' was a major disadvantage or challenge to using games in the mathematics classroom. The interviews provided further information on how time might influence the use or non-use of games to teach mathematics. In this section I examine game-users and then non-users statements regarding the issue of time in relation to teaching mathematics through game play.

Four of the seven game users raised the issue of time in their interviews. I asked Vero, who used games but not cultural games, why she did not use cultural games. Her response was:

> *The timetable that spells out the period for teaching mathematics is so short that you can't put games in that short period. Using games in teaching mathematics means you are going to use a lot of time to be able to come out with your concept*

> *or whatever you intend to put across for children to understand ... But it is structured in such a way that if you mean to use games most of the time you will see that you won't cover the structured syllabus.... You see games are just to let the child establish ... concepts but the mathematics syllabus is mostly based on exam. So ... we teach to get the children to pass the exams. And so games are used sparingly.*

Upon further questioning, Vero explained several factors contributing to the extra time required for games:

> *You know if you mean to use games and you are taking the one hour putting the children in groups, if that is the case, or in pairs will take time; describing the game to them will take time, involving them in the game—they have to play the game for some time before they actually can grasp the concepts you actually want to put across. ...So if you are using ... games almost every day for your teaching it will* [take] *a lot of time and you may not be able to cover the syllabus.*

She also mentioned that,

> *when the children get interested in the particular game it is difficult for them to stop the game ... in order ... to go on with your lesson. So,* [a game] *wastes time and if you are not careful, you may not be able to cover the objectives that you set for yourself for that particular day.*

Vero's goal is to cover the syllabus so that children *"pass the exams."* In her view, games may contribute to the initial development of a concept, but the length of time it takes to put children in groups, provide instruction, allow children to play the game, and

then halt the playing may outweigh the advantages. Since games are not tested on the exam, they should be used sparingly.

While Vero provided the most extensive response, other participants also shared similar concerns. Selina stated:

> *Sometimes they use a lot time. So, if it is 60 minutes after doing the game and if children are very interested, how to stop will be a problem and secondly the time that you will finish and go back to talk about the real one* [actual teaching], *time is gone. So it is good but it consumes a lot of time.*

Both Vero and Selina stressed that when children get excited in the games it becomes difficult to stop them and begin other activities and that time is wasted in transitions between multiple activities. Selina also seems to indicate that getting children involved in playing games is not 'real' mathematics teaching and takes more time.

When Gevase, another game-user, discussed the challenges he finds with using games he mentioned, *"The timetable also counts. Some games need more time. Some games need 30 minutes or 60 minutes lesson and if the game that you are to use involves a lot, then you can't."* When I asked whether he views time as a real problem he responded: *"Yes. Time is a factor in the sense that if most of the pupils don't know how to play the game you need to take your time to explain to them how to play."* He thought it was particularly problematic where *"you have to play the game and introduce the concepts that same day. Then you need time. The children must necessarily know how to play before the concept comes in."* However, he did concede that time was not a major factor if playing the game and introducing the concept (viewed as separate activities) occurred on different days.

I specifically asked Jane whether time was a problem when incorporating games in her classroom and she responded with an emphatic *"No."* She argued that *"Even if the time is* [a problem for a particular lesson], *you can* [re]*schedule your time. You are not a slave to your time."* Jane was the only participant who viewed the teacher as being in control of time in the classroom.

All three of the non-users expressed the *"time factor"* as a major reason for not using games. When I asked Vida why she does not use games, her immediate response was *"[t]he time factor"* and went on to explain:

> *When we talk of time factor as I was saying, you know children like playing. They enjoy it. Naturally children enjoy playing certain games. So...let's say math is one hour. That one hour ... introducing children to the game leading to the topic, before you realize you have chopped inside maybe the English lesson. The hour that I will use in teaching English, part is used in the math period.*

Knowing that mathematics is scheduled in 60 minute periods I questioned Vida further about how long it might take to introduce a game. Initially she said, *"it depends on the class size. If you have about 60 children in the class, it is going to be difficult."* I asked her to consider her own class and she seemed to retreat from her initial stance:

> *My class will be ok. ... I have 34 children and I think I can group them in maybe five or six groups. I can use 30 minutes for the games— introduce, and then get to the topic exercises until it is time. That I can do.*

Although Vida seemed to concede that she may have time to include games, all three non-users expressed concerns about the instructional timetable. Doris stated, *"the time is*

*scheduled for me* [and] *I plan the lesson myself according to the time* [and feared to use the games because] *they* [may] *chop into other periods."*

Ruth also presented a similar concern:

> *You are given only one hour for mathematics. By the time you organize the children to play the games, time will be up and you have the next lesson. You are the mathematics teacher in the classroom; you are the English teacher, about seven subjects. So you can't get time to use games.*

Expressing her worries about the use of these games in teaching mathematics, she argued that *"If we are to use games, at least the time should be extended. From one hour to one and a half hours for mathematics."*

From the non-users' perspective, although they did not use games, they tended to envisage that using games would take more time than was desirable. All three also mentioned the rigidity of the classroom scheduling. Both Vida and Doris used the metaphor of "chopping into other periods." Apart from Doris who had a very large class, both Vida and Ruth had relatively small classes, yet they talked about the difficulty with using games when dealing with large classes.

Both users and non-users of games expressed a view that time presented a major obstacle for the use of cultural games in the mathematics classroom. More specifically they stated that games may take excessive time to set up, to organize the children, to provide instructions for playing, to provide sufficient time to play, and to halt the games once started. The rigidity of the timetable and the frequent comments about the lack of time may refer to an underlying concern that using games would be at the expense of

class time for other subjects or that they would be unable to cover the objectives or syllabus in mathematics.

Gevase's assertions that the time used depended on the nature of the games and pupils' familiarity of how to play the games caused me to explore with participants the suitability and accessibility of cultural games for classroom practice.

*Suitability and accessibility of games*

Another factor mentioned by approximately a quarter of the participants in responding to the survey question on the disadvantages of using games in Chapter IV was difficulty in accessing cultural games and appropriate materials (see Table 10). Accessibility of cultural games was an issue for both game users and non-users. While some participants thought that cultural games were ubiquitous and accessible, others expressed that the accessibility of games for classroom practice was problematic.

When I asked Edith whether cultural games were suitable for mathematics teaching her response was *"Yes ...Cultural activities, we should not forget of them. They are part of our daily life so when you are doing anything they should come in school situation."* When Vero was asked a similar question about the suitability of cultural games, she responded, *"Not all. You should be selective depending on what you want to teach."* Some *"may not be suitable."* Although most interviewees did not comment directly on the suitability of games, several of them expressed concerns about the accessibility of cultural games.

In the game-users category, I asked Jane whether cultural games were accessible for mathematics instruction. Her response was: *"Where? They are not there. Even if they*

*say we should use the games, we will not get the materials. It will be a problem for us."* *"If the materials are not there, how can children get them to play?"* Martha questioned.

Gevase agreed. He believed that the games are *"not easily accessible."* He explained:

> *If you are a teacher and you yourself don't know it* [the game]*—you've never seen it before—it will be very difficult for you to even mention it in classroom. So it is just a few* [teachers] *who have the knowledge and who have ever played such games and have realized their importance* [who] *will try to use them in the classroom. So it is not all that accessible.*

However, unlike Martha, Gevase believed that with appropriate planning the challenge to provide materials was not insurmountable. He stated that, *"I think the teacher can provide the materials. Once you are coming to use* [the game], *you pre-inform the children to bring such things to school. The materials that you think you will use they will bring them to school."*

He added:

> *if it is not something that can be locally procured then you can let the government do that. If it is something that involves a lot and you think that yes I want to use local games to teach and the materials are not there I think the government can come in here and other organizations like Non-Governmental Organizations (NGOs).*

When I asked him how the game that he uses might be made suitable for use in the classroom, he said:

*Even where I used it, it was on a board. It was during my out year program, it was a board. You go to the carpenters and describe how you want the thing to be made and they will make it for you. In the local communities you use stones on the ground but if you want to use it in the classroom you have to consider the safety of the children. When you go to the carpenter or the shop you just give him the design and the number of marbles you will need. You can use paint to paint it in the different colours that can be used in the classroom.*

Vero was much less concerned about the availability of materials.

*Children play them and they know the materials … They know them better than even the teacher.* [So] *they are accessible provided the children are interested. If they are interested they know them."*

Vero also argued that even if you *"don't have enough materials ... you will look at the type of materials that are needed and you improvise. Materials can be improvised."*

Selina also shared the view that for *"some of the games, you will not get the materials"* and if you cannot find them, there are two options. *"You stop doing it* [i.e. using the game] *because if you don't have the materials, the children will not understand. But if you can improvise some materials in line with* [the game] *you can use* [it] *for the children to understand."*

Accessibility of materials was less of an issue for two of the non-users. Vida suggested *"[w]e can make some in the classroom.* [For example,] *kuriyee-kuriyee we are using stones."* Ruth initially contended that cultural games *"have no materials."* However, she immediately reframed her statement as she explained the childhood games she played. *"We normally use sticks and stones in our play. In the aŋlee, we use our*

*cloths ... we beat the cloths to get some sound."* She expressed concern that as teachers, *"we may not get the necessary equipment for the games"* to teach mathematics.

Although there were limited views shared on the suitability of cultural games in the teaching of mathematics, participants did make several comments regarding the accessibility of games and appropriate materials. From the users' perspective, most of the participants initially felt that the accessibility of games and materials were problematic. However, they suggested the teacher may improvise materials needed provided (s)he is aware of the games and knows the mathematics they can suitably teach. The teacher may actively involve children to bring materials in or solicit assistance from the government or Non-Governmental Organizations (NGOs).

*Awareness of the mathematics in games*

A key factor in the use or non-use of games in the mathematics classroom is the teachers' awareness of the mathematics in the games and their knowledge of playing and teaching through games. Since the curriculum gives no explicit information of what games to use and also does not specify the mathematics content the games could teach, I explored participants' awareness of what mathematics a child might learn from cultural games.

When I asked participants what mathematics children can learn from cultural games Gevase who mentioned several games but, in practice, only uses a pebble-sowing game said:

> *With that game the children can learn ... angles, lines, even counting .... That game involves a whole lot of mathematical way of thinking because you should*

> *know the sort of hole to play your marble in order to win the game. ... the concepts are many. For instance, if you take the addition, I mean counting in general, is one of the concepts that one can learn from the game.*

However, for the many cultural games that he mentioned and described in his community, he said *"because I don't use them, I can't say anything about them."*

In her response, Jane indicated that children *"can do subtraction, and maybe division, and then multiplication"* in her stone-passing game, *kuriyee-kuriyee.* Interestingly, Edith also mentioned several games, including the hopping game, g*onlaa,* and the stone-passing, *kuriyee-kuriyee* and many others. Similar to Jane, Edith often uses *kuriyee-kuriyee* to *"learn addition and even subtraction"* and *gonlaa* to *"learn subtraction."*

Paul seemed to have a wider knowledge of the mathematics children might learn from a variety of games. He mentioned four games that he often uses to teach mathematics, namely *paasaa, amina, bie-ziɛbu* and *bombo*. In describing his instructional procedures I asked him what mathematics children might learn from *bie-ziɛbu.* He said: *"children really will learn numeration– say counting of numbers, more than, or less than.* [In addition], *they also learn computation, division, and multiplication."* Also, when asked to describe the activities that might go with the games, his description specified *"I use it* [*paasaa*] *for counting";* we can *"use* [*amina*] *to teach multiples of numbers... you use* [it] *to learn even and odd numbers"*; *"you use* [*bie-ziɛbu*] to *teach addition"* and *"bombo is associated with counting. I use it to teach multiples."*

Although Selina was able to identify many games that could be used to teach mathematics, she only uses pebble-pushing *(baa-baa)* in her classroom. When I asked

her what mathematics concepts are developed in this game, her response was: *"Counting. When you are measuring with the palm, you count the number of times you have measured and also go and draw the same. … Measuring, counting, and drawing are all the activities."* Martha who uses the jumping game *ampe* to supplement the number line concerned herself with number concepts and said counting was a major concept. She noted that during play, they count in the mathematical language used in the classroom and so *"when they are counting, they don't count in the local language. They rather count in the English language and they* [become] *… fluent in the English language."*

Even though Vero uses only common games, she knew that *"cultural games help in the establishment of concepts."* When I specifically asked her whether she knows the mathematics of cultural games, she demonstrated her awareness of the mathematics of various games in this response:

> *If you are talking about the local game like baa, they measure, they count, and they also learn measurement at the same time. If you are talking about the bie, you are counting while putting the things and collecting; then seeing the number of seeds that you have in your hand.*

Cultural game users tended to exhibit their awareness and knowledge of the mathematics of at least one type of cultural game they mentioned. It is not surprising that they tended to be more knowledgeable of the mathematics of the games that they often use. Although Vero does not use cultural games, she demonstrated knowledge of mathematics found in cultural games.

The non-users gave similar responses as to what mathematics children might learn from cultural games. When Doris, said *"children easily learn from the games,"* I asked her what mathematics children might learn from the *kuriyee-kuriyee* she mentioned. Her response was simple: *"Addition. They can learn addition from that."* Ruth did not identify any specific cultural game but she felt that they can be used *"to learn prime numbers, odd numbers, and what have you. Then even subtraction and division you can learn from* [them]*."* Vida responded: *"I know that there is a lot of mathematics in games. In the new books, there are a lot of mathematics games."* But when I asked her to discuss traditional games in particular, she said, *"The traditional ones, it is recently I realized there is mathematics. I didn't know."* She continued,

> *From the day you talked about the games in the questionnaires, you know we were discussing them. Then we took some of the games and then we realized that if the children are playing ampe, we realize they count. So as they count, the counting is the game. You know in ampe if I bring my left leg and somebody brings the right, positive and negative changes are there. That is where I realized that if we take this particular game, counting and other aspects of mathematics come in.*

Among the non-users, while Doris and Ruth were aware of and know that there is some mathematics in cultural games, Vida was neither aware nor had knowledge about the mathematics of cultural games until her involvement in this research.

When I asked Vero what one needs to know in order to use a game to teach mathematics, she said: *You must know the concepts you are going to develop or what ever topic you are teaching—what the game will enhance in the learning of that*

*particular topic."* You must also know how children *"play the game and play it well in order to be able to grasp the concepts. Otherwise children will be fumbling with things without knowing what they are doing."* Based on what one needs to know in order to use games, she expressed her worries about games in the textbooks that she may not know as a stumbling block.

> *My only worry is for instance in the classroom situation where I use the textbook and a game is mentioned and I don't know how to use it. That is my only worry. Apart from that, when I know how to do it and I know it is for a purpose— it is for me to help children learn and learn properly, I don't see any problem using games.*

Gevase also lamented that *"teachers, even including the pupils, don't know the value of some of these traditional games."* Similarly, Jane pointed out *"we didn't even know the importance of using games for teaching"* as there were no games in our teacher training. Also, when I asked Vida why she does not use games, she explained *"we do not know how to use them in teaching"* while Doris personalized this limitation saying *"I don't know of any traditional game to use in teaching mathematics. ... I don't know what games to use to teach mathematics."* In expressing her concerns Jane, therefore, argued that *"[e]ven if you stress that we should use the games, yes, we go into the classroom* [and if] *we don't know the games ourselves how are we going to use them? That is my concern. We don't know the games."* Edith also felt her knowledge was deficient by her comment, *"You will be doing it but you don't know whether you are correct or wrong."* It also accounted for Doris's assertion that anytime she saw games in the curriculum *"I don't do anything. I just ignore them."*

Even though participants mentioned a wide variety of games within their localities most demonstrated knowledge of the mathematics in only a few and did not know how to use them in their practice. Nonetheless, in the few games that participants did mention, there was an awareness of the potential mathematics involved in all strands within the curriculum, such as counting, numeration and basic number operations, shapes, measurements, and mathematical language.

*Space*

Large numbers of students resulting in limited class space and management problems were cited by 28% of participants surveyed in Chapter IV as a significant challenge to the use of games in teaching mathematics (see Table 10). I explored the issue of class space by asking participants about their concerns regarding classroom conditions for using games.

Concerns about class space were mixed. Vida with 34 pupils does not use games. Nonetheless, she *"realized most of them can be done in the classroom"* and believes that *"in terms of numbers/space, it will not be a problem"* using community games in her classroom. Although Selina had 50 children in her classroom, she also stated she had no problem using games in the class. However, when I asked Edith who teaches a grade two class with 82 pupils, her response indicated a struggle:

> *Uum. There is no space in the classroom. No space so you have to squeeze and it makes everything very difficult. When we are doing the game, we come outside. As for the classroom, it is out. As for the classroom, it is packed to the blackboard and it is impossible for a teacher to stand and supervise.*

Gevase also conceived teaching in a large class a major challenge that renders some games unusable. He explains:

> *It is not easy. It is not all the games that can be used in a large class. Where the people are many it creates problems. For instance, if you take this 'ansokyire', where the people are to sit in a circle if the people are many and the class is too small it will not be easy to use it. The space of the class also counts. If the class is not okay then you can't use it. You can't use some of the games.*

From the participants' stories, they seemed to look at class space from two perspectives: the ratio of the number of pupils to the size of the class and the space needed to play the cultural games. Both Vida and Selina seemed to have large classrooms allowing more space per student. For Edith's class, there were far more pupils than the class could adequately contain and there was limited space for instruction so that using cultural games became problematic. Gevase also considered that the nature of some cultural games (e.g., those requiring children to sit in a circle) may not lend themselves to the classroom space.

However, Jane who usually combines the classroom and the playground in her instructional practice did not see class space as an issue. She believed that a game does not necessarily need to be played in the classroom. *"At least you can go out. If the class is not conducive, you can get a shady place and go out to use the game and go back."* Vero also had a similar view when I asked about her worries using games. She said *"I could be worried because sometimes I don't have enough materials, you don't have enough space"* but thought that *"where there is no space, then you look for a wider space—like getting into assembly hall or getting out to the space under a tree."* Paul felt

that even if the teacher can go out with the children, there is still the need for space to store materials safely in the classroom. He expressed:

> *For the classroom too you should be able to have a place where you can keep* [materials]. *You see some of them you cannot just keep them* [exposed] *for a long period of time. Sometimes you keep them* [exposed] *in the classroom and go realize that ants or termites have eaten parts. They are those you make with cardboard or papers. But if you have proper place whereby you can keep these things, they will always last long.*

Although participants expressed contrasting perspectives on the issue of space for using and storing games in teaching mathematics, they accept that using games requires more space. Classrooms with limited space tend to make either the use of some cultural games impossible or ineffective. Some participants suggested that the playground could be used as a substitute for classroom space but other participants raised concerns about the health risks of that option.

*Health and Cleanliness*

In response to the survey question on the disadvantages of using games in teaching mathematics ten percent of the participants mentioned health related issues (see Table 10). I sought to understand how using cultural games in teaching mathematics may result in health related problems.

Selina recounted the many games she used to play during childhood at home. When I asked her whether they also played these games in school, she responded *"we used to play but these days they say children will make their things dirty, so they don't*

*allow such games to be played."* In particular, she remembered her popular game *baabaa* and said *"We played it in school."* From her earlier response that they do not allow cultural games to be played in her school, I questioned whether it was the school or an educational policy that disallowed their play. She responded *"you know as for this school even playing ball when it is not time for games they don't allow it. ... A play that children will wear their uniform and sit on the floor is not allowed in our school."* When questioned regarding playing cultural games in school, Gevase responded *"Yes. Even when I was in college I used to play them"* and Vida's response was also *"Yes. When we were in the primary school, most of our break time we used to play ampe. Bisogi too. We used to do it during break time."* When I asked specifically about playing games in the classroom, Vida responded *"Not in class."*

The participants remembered that they played various cultural games when they were in school but not in the class. Only Selina indicated that only official games like football may be played at designated times but cultural games, many of which are played on the ground, are prohibited for health reasons in her school.

Vida also stressed the issue of health. She said *"[s]ome of these games are to be done outside. ...* [children] *will be playing with sand and get dirty. So maybe before you start giving exercises, the children will be dirty——their clothing."* She indicated however that *"it is not applicable to all games."* Similarly, Vida expressed her concern that when using the playgrounds *"children's clothing will be dirty."* I explored the potential health risks with Vida by asking her whether children become dirty in all games. She responded, *"No. It is not all. Like ampe and kuriyee-kuriyee children will not get dirty. But there are some that involve the sand. In the use of sand, they will definitely*

*use their hands."* When I asked which games she was referring to, she said *"Let's say kuriyee-kuriyee they use stones but if it is outside you know they will definitely touch the floor. They will use* [their hands] *in their books and maybe their dresses." "Don't they wash their hands after the game?"* I questioned. *"Yeah. That is, if the school is provided with basins and water. But you know children at times they will see the water and they will use* [their hands] *on their bodies."*

Both Selina and Vida suggested that there was a health risk involved with games where children use sand, sit on the ground or play in the sandy play ground. Although few participants commented on health related issues, the conception is that using cultural games in dusty environments poses potential health risks.

### *Inappropriate use of games in teaching mathematics*

A very small percentage (3%) of the participants surveyed mentioned issues related to the misuse of games in teaching mathematics (Chapter IV, Table 10). Considering the fact that only 22% of the participants indicated they use cultural games in teaching mathematics (see Chapter IV, Table 5), I specifically asked three participants (one common game user, one non-user, and one cultural game user) whether they felt there were misuses of cultural games in teaching mathematics. Participants shared some of their concerns.

When asked about possible misuses of cultural games, Vero focused on the learning objectives and said, *"There could be. If you don't link them* [the game and the objective] *up properly or if you pick up the wrong game for a topic, there will be a misuse. Sometimes it is not appropriate."* Giving an example, she said:

> *For instance, singing is not a game but I am just trying to cite it to say that sometimes it is out of place. In a certain cluster some NGOs encourage that. Students should use songs to introduce their lesson, and conclude with a song. But I notice that the songs the children were singing and the topics that were taught there was no link at all.*

As a resource person for teachers' professional development, Vero often emphasizes to her students to choose *"one that will be suitable for your topic... you just don't pick a game because you want your class to be interested in what you want to teach. It must have a link with the topic."*

In response to the question on the misuse of games, Vida focused on the teacher and responded, *"Yeah.* [Misuse] *is possible. It can happen....Like people assigning children to play a particular game—you know it will keep them busy then you sneak out to do your own things."* But she still insisted that,

> *We should use* [games] *because it is not all teachers who will sneak out. It depends on the supervision in the school. Like in my school, the head goes round. So you know, like I know, he knows, so no one will even do that.*

Paul focused on the limitations of teachers' knowledge as a key factor likely to encourage possible misuse. Paul explains:

> *In fact, the most important thing is the learning. If you are able to teach them* [pre- and in-service teachers] *how to use them* [games], *they* [teachers] *can cope up, but if they don't have any knowledge about them, sometimes you will see that you have a problem. They may misuse them but if you teach them they may cope up.*

Comments from these three participants, though varied, tended to indicate that there could be a possibility of misuse of cultural games in teaching mathematics. They cited a range of factors such as the nature of human behaviour, inappropriate choice of games for topics, teachers leaving students unsupervised, and lack of knowledge by the teachers as likely to result in the misuse of cultural games in teaching mathematics.

### *Cultural knowledge acquisition*

In response to the question, "What do you think is the purpose of playing games in the community?" (Chapter IV, Table 8), 21% of the surveyed participants stated that cultural games sustain and keep the cultural heritage alive or, in general, promote the acquisition of cultural knowledge. In this section, I examine participants' comments on how the use of cultural games in teaching mathematics provides children with opportunities to acquire cultural knowledge of their communities.

I asked participants: "What are the benefits of cultural games to the community?" Selina emphasized the value these games have in both the community and in school:

> *The children when they play games in school like this, they know that games are valuable. They will see that children come together .... If the parents are talking about it they will say that madam has used that thing to let us learn in the classroom. So the parents will know that games are very valuable in school.*

Similarly, Vero believes that using cultural games will educate the community and help them recognize the value of games as instructional tools:

> *When children play, it amuses the community. For instance, when they begin to play the games that the community members are already aware* [of], *they are impressed that even children going to school still take part in these local games that we have. They are amused and they* [will] *sit down and just admire* [children playing them]. *They* [will be] *impressed about the way children are intelligent in doing certain things which sometimes even adults cannot do. So they admire the little ones* [playing the games].

She continued emphasizing the link between the mathematics classroom and the community by noting that children:

> *will come to school and before you are aware, before you make anything formal, in their informal way they are in it. They are doing the golaa, they are doing the ampe. No one will instruct them to go and do ampe,* [or] *go and do what. ...They bring the community to the school and so during break nobody instruct anybody to do anything and you see them doing the games that they like most.*

Martha also said she made efforts to link her topic in the classroom with children's games. For example, she noted that children *"have been playing ampe any time they go out for break."* When they return to the classroom she uses the children's familiarity with that game as a connection to *"addition of numbers, adding numbers, using the number line."*

Paul also focused on the learning relationship between home and school in his use of cultural games. In his view, cultural games provide opportunities for indigenous communities to acquire formal mathematical knowledge without formal schooling. Paul explains:

> *In fact ... the community also learns from you the teacher as well. ... They also learn the sense that is entailed in the games—the mathematical sense or the mathematical concepts that these games have. Like if the children come to school and you teach them that this game has got these mathematical concepts, they will take it back to the community and tell their parents or other children and teach them. So by the time you realize the whole community is even learning mathematics without your knowledge.*

For Paul, such interactions indicate that other children in the community will get to know some formal mathematics *"even though they haven't been into the classroom."* In this way, cultural games tend to create local community relations, foster access to knowledge and provide opportunities to distribute new knowledge. As children re-unite with their friends after school and share the new knowledge learned in school with them, Martha felt that through such sharing *"a clever child may also get to know what they have been doing in the classroom."* In particular, through informal interactions on cultural game use, formal mathematics is distributed across the community *"as they will go around telling the others that this fellow came and taught me how to count"* or do other things in a particular game.

The participants' comments seem to indicate that cultural games in the mathematics classroom not only influence community relations but also serve as a mechanism for the transfer of mathematical knowledge and understanding between schools and the community. Vero, Martha, and Paul felt that using cultural games in teaching mathematics brings the community to the school. Not only is indigenous knowledge brought into the school by the children, but the knowledge is further processed and then

returned to the community at a higher level of awareness, appreciation and understanding. Participants appeared to believe that cultural games bring joy to the community and contribute to the intellectual development of the child, the teacher, and the community through knowledge distribution.

### *Motivational attributes*

Fifty-one percent of the surveyed participants stated motivational attributes as one of the reasons for playing games in their communities and 57% of the participants viewed motivation as an advantage for using games in teaching mathematics (see Chapter IV, Tables 8 & 9). In this section, I present the interviewees views on the value of cultural games from a motivational perspective.

When asked about the benefits of games to a teacher, Vero laughed and said: *"Interesting*! .... *The lesson is interesting to me when I walk around to observe what the children do. I enjoy it. And to the children, they enjoy playing games."* As a game-user and a lover of games, she liked games because *"It is interesting to partake in a game."*

Similarly, Paul said *"the benefits of these games are that they make my lessons very interesting."* He summarized what he liked about cultural games when he said: *"One thing I like about these games is just the fun and the satisfaction they give. They create fun, you laugh a lot and they make mathematics easy."* Using specific examples to explain his reasoning he said:

> *OK. Let's take the game paasaa, for instance.... So it involves the pupils much more in the lesson. So pupils pay much more attention on whatever I am going to teach and it arouses their interest. The bombo and the bie-ziɛbu–these games also*

*create fun and satisfaction and sometimes they occupy the children during their free period. .... The amina as I told you ... it just arouses their interest, create fun for the children. It is fun. Yeah. When children play, I am happy about them.*

Martha expressed similar sentiments on the benefits of games to children in her response:

*[T]hey carry out the lesson very well because ... you know, children – they like playing and when you put mathematics in that form they feel it is just a play and through that they achieve their aim very fast. And even the lazy ones can also act. ...using these games, children become very active ... and once they are active you will get much attention—you will draw their attention easily. Their attention is always captured very fast. Everyone will want to take part.*

Gevase expressed the effect of interest on participation:

*When you also sit there if you don't take care the whole of that day you will not even like to eat because it is so interesting. .... It keeps you there because if somebody wins and you think that you are also good in it you will also like to play back. So it will just keep you there forever and if you don't take care you will not get up for the whole day.*

Children's participation is enhanced not only because the games are interesting but also, as Edith's indicated, because *"the games make the lesson practical and they are motivated. Everyone will like to take part."*

Since interest encourages participation, Jane felt that games should be introduced into mathematics to activate learners anytime they are inactive. In particular, she said *"in*

*the process of teaching sometimes ... when you see that a number of children are sleeping you can let them ... play* [a] *game, and when they play they will be active."*

Views shared by game-users suggested cultural games motivate both the child and the teacher in different ways. I asked Selina what motivated her to use a cultural game in teaching mathematics. She said, *"First, the game helps the children to pay more attention. Secondly, all the children will be involved. It is a kind of motivation so that children will participate in the lesson. ... It is very interesting"* and she liked using it because of *"the competition* [and] *[t]he way the children are enjoying it."* Selina also advised that a *"game that is in line with your topic, you can use it to bring the children's attention to the lesson."*

Ruth, although she does not use games, thought that *"[i]f we are using games, the children will develop the interest at once."* She argued that *"[t]hese days children like play so I think it is good to use play."* Similarly, although Doris does not have any interest in using games to teach mathematics, she acknowledged that *"It is good to use games to make the mathematics learning interesting for them to learn."* For her, *"games make the lesson interesting."*

When I questioned whether children like mathematics, in particular Jane noted that *"[m]ostly children don't like it but it is you the teacher who would let them like mathematics through activities and games"*

In view of the motivational functions of cultural games, Vero advised that:

> *You don't stop children from playing games either at home or in school because even games, as it stands even if it is not for a learning situation, ginger the children up. Some sleep in class but when they are out and they get themselves*

*involved in games and they jump around, they come back to class more alive than before. They sit more awake and more critical about the teaching that is going on in class than when you make the class so boring.*

She however, cautioned that excessive use of games may de-motivate *"those who are not interested in games."*

From the interviewees stories shared here, all share the view that cultural games are catalysts for learning mathematics. They make the lesson interesting not only for the child but also the teacher. Most participants believed that because the games are interesting, they focus children's attention on the learning situation and induce active participation and involvement in the learning process. Only one participant cautioned that the excessive use of the games will not be beneficial to students who are not motivated by playing games.

## Advice: Fostering the Use of Games

The preceding sections in this chapter provided a better understanding of the challenges of using cultural games in teaching mathematics. However, since the curriculum is not explicit in its treatment of the use of these games in the mathematics classroom, I used the interviews to explore teachers' advice on how the use of games may be fostered in the mathematics classroom.

Vero focused on the teachers' professional capacity and said:

*Truly to enhance teachers' ability to use games, they need to organize in-service training for teachers from time to time and let them go through a lot of games themselves, experience the games themselves during training before they come*

> *back to handle them. The fact is that they should use the syllabus and know what games will go with each of the topics. Then develop the teachers in that wise. So that when they come to a particular topic that need a game* [experience] *to build ... on, then the teachers use that game to let the children develop the concepts properly.*

Similarly, Jane also focused on the periodic upgrading of teachers' knowledge base and suggested *"In-service training."* To enhance our capacity to use cultural games, she argued:

> *We must meet people who are competent in mathematical games so that they come to teach teachers. Most of us don't know because we don't have in-service training.* [If] *they come to teach us we will even be relieved of our tiredness.*

Gevase was particularly concerned that only a few teachers have the knowledge and have realized the importance of cultural games and when asked what could be done about that, he said:

> *I think what they* [curriculum developers] *are supposed to do is to introduce more of the traditional games into the syllabus, the syllabus of teacher education, because that is where the methodologies and all these things are learnt.*

He thought that teachers should use the games to show others their real benefits because *"[w]hen other teachers see that the use of traditional games have improved the teaching of mathematics ... Some of them will be encouraged or will like to try them in their classrooms."* In this regard, he is of the view that we should

> *let other teachers know of this. It must be introduced into the syllabus of teacher training colleges so that teacher trainees before they come out* [of college they]

> *will know that there is so much importance attached to traditional games in teaching mathematics. When they come out they will be using this in teaching mathematics. But if they go there and they never hear of any traditional game used in teaching mathematics, when they come out they won't do it. ... Also* [it will help] *if we have resource personnel come to the schools to educate students on the importance of using traditional games in teaching mathematics.*

Even though Ruth does not use games, she is of the view that *"we can include games in our syllabus or in the pupil's books.* This is particularly important as Selina noted that *"[s]ome colleges do not teach or encourage the use of traditional games."*

From the advice shared, participants tended to agree that periodic in-service training for teachers on the use of cultural games, infusing cultural games in the syllabus and resource materials, and using cultural games in teacher education programs may foster the use of cultural games in teaching mathematics.

## Discussion

The interviews with the ten participants allowed me to expand on the findings from the survey results and further explore teachers' experiences and perspectives regarding the use of cultural games in the mathematics classroom. In this chapter, I explored teachers' conceptions of a game, their awareness of games in the curriculum, their experiences of games in professional development, and their perspectives of the purposes, advantages, and disadvantages of using cultural games in teaching mathematics.

Since the curriculum mentions the use of games without discussion, the participants interviewed revealed varied and at times contrasting conceptions and interpretations of a game in the mathematics curriculum. For example, an emphasis on competition and rules by some participants led to the rejection of some of the most popular cultural activities. Another issue revealed was the difficulty classifying which games are considered to be traditional and which ones are not. This difficulty suggests further problems as to how teachers determine which games are appropriate for inclusion in the mathematics classroom. The uncertainties and conflicting perspectives shared have an impact on how the curriculum is implemented.

Participant interviews also indicated that few teachers experienced the use of games during pre-service education and very few experienced their use during in-service opportunities. Sadly, of those who experienced games, the focus appears to have been predominantly on common (foreign), rather than cultural games. This finding is very disconcerting given that the curriculum promotes tools to build connections between schools and the community. With limited pre-service and in-service experience, it is unfortunate that most teachers in this study had limited knowledge of the mathematics in cultural games.

Another major portion of this chapter was to represent the participants' responses to the general question, "What are the advantages and disadvantages related to the use of games in the mathematics classroom?" I presented their responses using categories similar to those found in the survey chapter including: cognitive development, social interaction, games as an alternative teaching strategy, cultural knowledge acquisition and motivational attributes.

Although all participants concurred that cultural games develop children's cognitive abilities in learning mathematics, their beliefs about the value of the games for learning mathematics show stark differences as to how and when learning occurs. On the one hand, some participants believed that children can learn mathematical concepts directly as a result of playing the games; on the other hand, other participants stressed that learning occurred only when the teacher took an active role and explicitly made the connection between the mathematics in the games and school mathematics. Since the curriculum does not specify what mathematics can be learned through the games or how that learning might occur, it is not surprising that teachers expressed a wide range of beliefs about the value of cultural games for mathematics learning. Nonetheless, such contrasting positions about how children may learn through these games can give rise to conflicting methods of instruction.

In spite of participants' contrasting perspectives about how children might learn mathematics from cultural games, an important finding is that the social nature of cultural games provide valuable opportunities for building positive social relationships, allowing children to learn from each other. However, participants cautioned that the social learning environment of games may give rise to aggression and the level of noise may interfere with others learning.

The teachers shared a variety of perspectives on the advantages and disadvantages of games as an alternative teaching strategy. The most common issues raised included time, accessibility, teacher knowledge for using games, space, and potential health issues.

The study revealed that even if teachers are aware of the mathematics in games within their communities, issues related to time were frequently indicated as a major deterrent to the use of games for mathematics. Most participants seemed to believe that the time schedule for mathematics is inadequate to allow the effective use of cultural games for meaningful learning. Including games either meant not covering the mathematics curriculum objectives or taking time from other subjects in the timetable.

Another issue raised by some participants about cultural games as a teaching strategy was the accessibility of cultural games. The first aspect of this issue was simply having access to or awareness of the cultural games within the community that related to the mathematics curriculum. The second aspect was access to the materials needed; however, most participants provided various options for attaining the necessary materials. The third related aspect is access to appropriate classroom space. Although some participants suggested the use of the playground as an alternative to address the issue of space in over-crowded classrooms, that option may have serious health consequences that tend to make cultural games practice not viable.

Given that most participants interviewed had limited opportunity to experience the use of cultural games to teach mathematics, it was not surprising to find that many participants seemed to have limited knowledge of the mathematical content of cultural games and did not know how to use them in teaching mathematics. However, participants did seem to be aware of several cultural games in the school communities and that the games may be relevant to the mathematics curriculum.

All participants interviewed believed that cultural games are a catalyst in learning mathematics as they make the lesson interesting, induce participation, capture the

learner's attention and make them active in the learning process. They also strongly supported the view that using cultural games in mathematics teaching fostered a potential bond between knowledge within the community and school.

In providing words of advice, most participants suggested that teacher development is very essential to build their professional capacity towards the use of cultural games in the mathematics classroom. In particular, they suggested the use of cultural games in mathematics teacher education and periodic in-service training for teachers. They further suggested more attention be given to cultural games in the mathematics resource materials such as the syllabuses, pupils' textbooks, and an in-depth coverage in mathematics teacher education materials. In particular, since the curriculum is a carrier of values, the belief is that more attention to the games in the curriculum materials is an index of their value in mathematics education. An in-depth coverage of the games in the textbooks will guide a teacher on their use. On the whole, participants believed that infusing cultural games in the syllabus and resource materials, using cultural games in teacher education, and periodic in-service training for teachers can foster the use of cultural games in teaching mathematics.

In conclusion, the interviews provided further depth to the open-ended responses on the survey and further revealed primary school teachers' experiences and perspectives of using cultural games in teaching mathematics. In the next chapter I will discuss the implications arising from the study.

# CHAPTER VI

# FINDINGS, RECOMMENDATIONS AND IMPLICATIONS FOR CULTURAL GAME USE IN GHANA

The inclusion of games in the 1987 curriculum in Ghana prompted this study. The study investigated teachers' experiences and perspectives on the use of games in the mathematics classroom. Craft knowledge was used as a conceptual framework for the investigation and it is used in this final chapter to organize the findings and to draw implications for policy and practice.

In Chapter II, the conceptual framework described craft knowledge as a particular form of know-how that enables teachers to interpret, adapt, and implement innovative curriculum. In this study, it was argued that a teacher's craft knowledge plays a major role in the use and interpretation of games, particularly cultural games, in mathematics teaching and learning. The three sources of craft knowledge described in Chapter II are revisited here and placed in a context of using cultural games. In this chapter the findings, recommendations and implications for cultural game use in Ghana are discussed in relation to: the teachers' past experiences with cultural games, their current teaching situation for games and the teachers' vision of cultural games in the mathematics classroom.

## Teachers' Past Experiences with Games

One source for the development of craft knowledge is the teachers' past experiences. As discussed in Chapters IV and V, teachers' pedagogical perspectives and

decisions are partially based on craft knowledge of games arising from three domains of experience including personal community experiences, educational experiences, and practical experiences. Through the cumulative experiences with cultural games teachers tend to develop a perspective on the purpose and value of games in the community and for learning mathematics.

### *Personal community experience*

The data indicated that all teachers in the study have experienced a wide variety of games as part of cultural life in their communities in the past and present. These games were either experienced by observation and/or through participation. The degree of experience seems to be a function of the community where the teacher was raised as a child and where (s)he currently teaches. Teachers raised in rural communities tend to have wider range of experiences with cultural games in their communities during both childhood and adulthood than their urban counterparts. However, the games experienced by both groups are similar to what one observes and experiences in contemporary Ghanaian communities.

Several teachers spoke of their own experiences learning mathematics through playing games with other members of the community as part of their cultural life. They come to know various aspects of mathematics through their experiences playing the games. Teachers' use of games in the classroom reflects their familiarity with community games and their knowledge of the relevant mathematics within the games.

By reflecting on their personal experiences with cultural games, teachers in the study provided a wide range of purposes for playing games in the community. They

viewed games as important opportunities for socialization, motivation, cognitive development, acquisition of cultural knowledge, skill development, and moral development. Most teachers in this study mentioned social interactions and motivation as the primary purposes for playing games in the communities. When I embarked on this study, I believed that cultural games in the community provided a significant source for cultural knowledge acquisition; however, few teachers mentioned this purpose.

The personal past experiences teachers have playing or observing games as children and as adults, and their interpretation of the purposes of these games within the community, shape the teachers' craft knowledge and, hence, shape decisions they make with regards to playing games in the mathematics classroom.

### *Educational experience*

In addition to personal experiences teachers may have with games in their communities, they also have opportunities to experience the use of games in their education as children and later as part of their teacher education. Games became part of the mathematics curriculum in Ghana in 1987. Although some teachers in this study were not in primary school at this time, many participants experienced games in their education. However, only a small number of participants remembered experiencing games at the secondary level—even though many participants would have been in school at this time. The survey revealed that the teachers who reported experiencing games as children seemed more likely to use games as teachers. Although this relationship cannot be described as causal, it raises the question as to the importance of teachers experiencing games as part of their educational experiences.

Unfortunately, very few teachers remembered experiencing games as part of their pre-service or in-service education. The few that experienced games in their professional education recalled only common games, such as bingo and ludo, rather than cultural games. In fact, no teacher in the study indicated ever experiencing cultural games in mathematics in their pre-service or in-service development. The possible connection between the value of indigenous mathematics emphasized in the present curriculum and the use of games generally does not appear to have been made by the teachers or by educators of pre-service and in-service teachers. With few or no opportunities to experience cultural games in a professional development setting, teachers do not have an opportunity to further reflect on and transform their craft knowledge to consider the potential value of cultural games in a mathematics classroom.

In the interviews with participants, I asked many questions about their use of and perspective on cultural games in mathematics teaching. For many of them, it appeared to have been the first time that they had considered the potential of cultural games in the teaching and learning of mathematics. Several teachers in the study commented on the obvious lack of education they received in both their pre-service and in-service experiences. They expressed the need for teacher education to explicitly incorporate games in the teacher education curriculum and to use them to popularize their importance in mathematics education. They also suggested the need for in-service training to provide experiences that will enhance teachers' capacity to use games for teaching mathematics.

### *Practical experience*

Even though the use of games is an expectation in the current Ghanaian mathematics curriculum, less than half of the teachers reported using them in their practice. About one-third of the teachers used common games to teach mathematics and less than one-quarter appear to have used cultural games. The survey showed that generally more urban teachers than rural teachers incorporate games in their lessons. However, more rural teachers than urban teachers use cultural games to teach mathematics. Although the curricular intent was to link culture and mathematics, most teachers do not appear to have made the connection.

With the wide variety of cultural games available in the school communities, teachers who use them on a regular basis for teaching mathematics tend to draw on the most popular games in their communities, including jumping, hopping, stone-passing, and pebble-rolling games.

## Implications of Experience on Craft Knowledge

A layering of personal, educational and practical experiences is an important source for the development of craft knowledge. Teachers in the study appear to have rich personal experiences, but minimal educational experiences (beyond primary) and practical experiences with cultural games. Also, teachers have not made the link between the value of indigenous mathematics as expressed in the philosophy of the curriculum and the use of games as an expected teaching tool. Without appropriate educative and practical experiences, it is not surprising that there is minimal use of cultural games in mathematics teaching by these Ghanaian teachers.

Cultural games are a valued part of the cultural heritage in Ghana and many games are rich with mathematical content. The value of games appears to have been overlooked by teachers, teacher educators and policy makers. An implication of this study is for the explicit discussion and explanation of cultural games in the school curriculum, which should then provide sufficient incentive to address it more directly in pre-service and in-service opportunities.

Certainly one of the challenges of this recommendation for using cultural games in mathematics teaching is the variation of cultures in Ghana and the range of cultural games across communities. While a broad explicit statement of the use of appropriate cultural games in the curriculum may prompt changes to professional development programs, these changes must be discussed and enacted at local levels. Further research into understanding the mathematics of cultural games across the country to inform curriculum development is needed to better address the possibilities.

## Current Teaching Situation with Games

A second major source of teachers' craft knowledge is their current teaching situation. In this study, four conditions were found to impinge on the teachers' development of craft knowledge in relation to cultural games: the curriculum, time availability, classroom space, and accessibility of materials.

### *Curriculum conditions*

The curriculum advocates the use of games in mathematics and most teachers interviewed appeared to be aware of the curriculum suggestion to include games.

However, games are merely mentioned in the mathematics curriculum without elaboration. There is no information available to teachers as to what constitutes a game, how and when to use games, or what games to use for specific topics. Most teachers in the interviews seemed uncertain about what type of game to use and where cultural games fit in the discourse of mathematics curriculum implementation.

The interviews revealed that teachers have varied and at times contradictory conceptions and interpretations of what a game is and what cultural activity constitutes a game. Participants also had difficulties classifying games as cultural or not. This difficulty raises questions as to how teachers might determine which games are appropriate for inclusion in the mathematics classroom. Since teachers did not have educative experiences, received limited direction in curriculum documents and did not have access to resource materials it may be assumed that the teachers who used games in their classroom relied primarily on their personal experiences for determining which games were appropriate for classroom practice.

The curriculum does not seem to motivate teachers to include cultural games in the mathematics curriculum implementation and teachers do not seem to have support for making informed decisions on the use of cultural games.

### *Time availability*

Through the interviews, teachers stated that mathematics instruction commonly takes place during a double period (one hour) daily at the primary level. Yet, participant responses to the survey identified time most frequently as the primary disadvantage for the inclusion of games. Interviews with selected participants further revealed that for

both users and non-users of games instructional time is inadequate to allow for effective and meaningful practice with cultural games in the mathematics classroom.

Participants argued that using cultural games in teaching mathematics required substantially more instructional time than was available. As opposed to directly teaching curriculum concepts, teachers stated that the use of games required the integration of different activities, such as modelling how to play, allowing sufficient time to play, and making links between the mathematics in the games and school mathematics. In addition, participants stated that during instruction, time is wasted in transitions. As a result, many participants concluded that games required more instructional time than was scheduled in the timetable. Including games in mathematics lessons would be at the expense of covering the curriculum in mathematics or possibly in other subjects.

In addition to the extra instructional time required, teachers also indicated that the practice of using games requires more time for pre-lesson and post-lesson organizational activities especially in their large classes. More time is needed to prepare lessons, set up the games, and organize children into groups.

The availability of time was perceived as a major impediment for those who did not use games and teachers who did use games also expressed concerns about the amount of time for the use of games on a regular basis.

### *Classroom space*

A third condition that has an influence on teachers' craft practice with cultural games in teaching mathematics, as indicated by more than a quarter of the participants in the survey, is the available effective classroom space. Teachers' accounts through the

interviews indicated that most classrooms hold more children than expected and far more than the recommended class size. Under the conditions where classrooms are 'packed' with children and with virtually no space for free movement and/or practical activities, teachers tend to avoid the use of games as using them under such conditions was viewed as a 'struggle.' Part of the struggle was the rise in management problems, particularly for games and activities with high levels of interaction among students. Participants indicated that the numbers of students in their classroom and limited space would make games impossible or ineffective.

Teachers also indicated the nature of cultural games compounded the problem of classroom space. Some cultural games by their nature either require extensive space for play or cannot be played inside a classroom at all.

Several participants in the study attempted to address the problem of limited space in the over-crowded classrooms by using playgrounds as an alternate site. While this was viewed as a solution for some, others noted that playing outside could have serious health consequences. The playgrounds are dusty with potential health risks that for many teachers make outdoor activities unfeasible.

### *Material conditions*

Although the suitability of the materials was not deliberately explored with all participants, some teachers noted that many cultural game materials are not suitable for use in the classroom because of the nature of the games. For example, some cultural games traditionally require digging holes in the dirt, throwing stones, or jumping and kicking activities.

One advantage of the use of cultural games over common games is accessibility. However, for this study, accessibility was not simply having access to or awareness of the cultural games within the community that relate to the mathematics curriculum but also having access to the materials and the classroom space. Satisfying all these conditions as criteria for implementation appears problematic among teachers. Most participants thought that materials are readily accessible for most cultural games. Of the few games where materials are not readily available, participants suggested alternatives by improvising with other materials or soliciting help from children or the educational authorities.

## Implications of the Current Teaching Situation on Craft Knowledge

The emphasis on indigenous mathematics and the inclusion of games in the curriculum are to make mathematics accessible and meaningful to children. However, using games in the current teaching situation is constrained by the curriculum, instructional time, classroom space, and material accessibility that do not seem to favour the development of teachers' craft knowledge of games for effective implementation. Most teachers do not seem to know where cultural games fit in the curriculum, how to use them or when they come into play in mathematics curriculum implementation. These conditions impede the development of teachers' craft knowledge for curriculum implementation. If mathematics curriculum developers are committed to the inclusion of indigenous mathematics and view cultural games as a viable means to address such mathematics, then the four constraints of teachers' current teaching situation addressed in this section will need to be considered.

First, the curriculum needs to go beyond mere mentioning of games to including explicit guidelines for the use of games, particularly cultural games. Further investigation into how cultural games are currently used could serve as a frame of reference for curriculum development and implementation. Second, allowing teachers to understand potential long term benefits of games and how games allow for the integration of content may address some of their concerns regarding time. Teachers appeared to have limited flexibility as to how they might manage their time, not only in mathematics but across curricula. Creating awareness that teachers are managers of instructional time and encouraging the use of games in teaching across the curriculum might help teachers work within the given time frame effectively and yet cover the curriculum. Third, for game use to be expected in all classrooms class size policy has to be re-examined to allow free space for physical engagement. Reducing class sizes and/or enlarging the physical space available pose significant challenges but if mathematical games are to be made accessible and meaningful to children, there must be space for active engagement in practical activities. Finally, cultural games materials need to be developed to be attractive, suitable and accessible for use in the mathematics classroom. If these materials are available for classroom use, teachers may make efforts to use them. While the problem of accessibility to cultural games materials may be addressed relatively easily, the teachers' lack of awareness of the games relating to school mathematics appears to be a larger issue that requires further examination and education.

## Teachers' Vision of Cultural Games in the Mathematics Classroom

The primary mathematics curriculum currently places emphases on the development of basic mathematical content including concepts and skills in number, shape and space, measurement, collecting and handling data, problem solving and investigations. Using games depends on the teachers' awareness of the relationship between the mathematical possibilities in the games and the content domains delineated by the curriculum. It also depends on teachers' perspectives of the advantages and disadvantages of using cultural games in teaching mathematics. The teachers' awareness and perspectives of games lead to their pedagogical visions in the mathematics classroom. These visions constitute the third source of teachers' craft knowledge.

Drawing on their past experiences and current teaching situation, many teachers view cultural games as opportunities that enhance mathematics teaching and learning. In particular, teachers expressed the view that games present excellent opportunities for learning, provide an alternate method of instruction, and link schools to the community.

### *Vision of cultural games as opportunities for learning*

Throughout the study, teachers weighed the positive and negative aspects of games based on the impact they might have on children's learning of mathematics. In this study, teachers indicated that cultural games had the potential to impact learning in at least three ways: through content in the games, as social opportunities to learn, and as a motivational activity.

Games were generally viewed as opportunities for children to expand their cognitive capacity and to diversify their learning habits and skills. The interview data

revealed that although teachers viewed cultural games as aiding mathematics learning, they differed sharply in their perspectives as to how and when learning occurs. While some teachers held the view that children can directly learn mathematics through playing the games, others stressed that learning occurs only when the teacher plays an active role by explicitly linking the mathematics in the games and school mathematics. These contrasting views impact curriculum implementation and give rise to conflicting methods of instruction.

Not only do cultural games provide children with opportunities to learn, but the study also revealed that teachers could also benefit from further awareness of mathematics in games. Most participants in the survey recognized that mathematics across all curriculum strands were utilized in playing cultural games; however, that knowledge appeared limited primarily to number and number relations content. As has been mentioned, teachers who used games generally did so due to past experiences and personal motivation. By developing lessons that incorporated the use of cultural games, teacher knowledge was also developed further through three preparatory activities: in playing the games, in constructing the games, and in searching for game materials.

Three-fifths of the participants in the survey also viewed games as opportunities for social learning of mathematics. They felt that significant learning occurs through social interaction and that the social nature of cultural games enables learners to build positive social relationships and to learn through group work and discussions. Further information from the interviews confirmed that most teachers tend to view socialization as the core of learning together, collaboration, and the co-construction of knowledge.

However, the positive aspects of games as play and entertainment seem to be a concern especially among non-users who appear to be less supportive of the value of social interaction in learning mathematics. Many non-users could not envision socialization in cultural games as an important aspect of learning mathematics. Despite the numerous social benefits of cultural games in learning, both users and non-users were mindful that the social interactions in games may give rise to noise and aggression that may interfere with learning.

Motivation was another aspect of cultural games mentioned frequently in relation to mathematics learning. Many teachers expressed a vision of a mathematics classroom that is lively with all children involved in the learning process. Over half of the teachers considered cultural games as motivating activities that promote a lively learning atmosphere.

Cultural games, like common games, tend to activate learning. The participants interviewed shared a wide range of viewpoints suggesting that cultural games in learning mathematics arouse interest, induce participation, capture learners' attention and make them active in the learning process. Cultural games make the mathematics classroom interesting not only for the child but also for the teacher. In this role, games are viewed as motivational tools that stimulate children's mathematical imagination and thinking towards the production of mathematical knowledge in the classroom. Negative aspects related to motivation were also mentioned. A few participants assumed that games have the potential to induce dependency and divert attention. They envisioned the excessive use of games as detrimental for some students' mathematical development.

*Vision of cultural games as tools of instruction*

Games are incorporated in the curriculum with the intention that teachers will use them as alternative tools of instruction to make mathematics relevant, accessible, pleasurable, and memorable to children. Although about half the participants surveyed indicated using games in their mathematics lessons, sadly, only about one-quarter of the participants viewed cultural games as a positive teaching strategy. In particular, teachers mentioned that cultural games allow for a more child-centered approach and that it can be less tiring for the teacher.

Almost two-thirds of the participants, however, thought that using the games as a teaching strategy is fraught with disadvantages. In their view, using games is time-intensive in effort and management. In addition, there is the issue of lack of awareness and knowledge of the mathematics of most cultural games. The lack of knowledge has a severe impact on their ability to envision themselves using games in the present or in the future. Consequently, although cultural games were generally viewed as positive tools for learning and motivation, many teachers may felt that the disadvantages associated with using games as a teaching strategy outweigh possible advantages.

*Vision of cultural games as opportunities for school-community linkage*

Many teachers expressed the view that cultural games provided opportunities to establish school-community relationships. In their view, using cultural games in teaching mathematics facilitates the learning of informal and formal knowledge. Children re-unite with their friends and parents after school and share the new knowledge learned in school with them. Through the informal interactions, mathematics is shared across the

community and members get to learn mathematics without formal schooling. In this way, using cultural games can serve as a mechanism to transfer mathematical knowledge and understanding between the school and community. Indigenous knowledge is not only brought to school by the children, but the knowledge is further processed and then returned to the community at a higher level of awareness, appreciation and understanding. In this sense, using cultural games contributes to the intellectual development of the child, the teacher, and the community. Using cultural games in teaching mathematics integrates informal and school knowledge.

## Implications of Vision on Craft Knowledge

Teachers' perspectives of cultural games in the classroom influence their pedagogical decisions and actualize their vision of teaching. Teachers focus on activities consistent with their visions and develop practical knowledge towards achieving the desired goal. The vision of cultural games for teaching mathematics appeared to be developed by some individuals in isolation based on personal experiences and interest. Developing craft knowledge and a vision for using cultural games more broadly in mathematics teaching requires extensive opportunities for teachers to share and reflect on their experiences, their current practices, and their vision of teaching. For teachers to develop their craft knowledge of games requires opportunities for sharing and reflecting on their visions with others—first, with other teachers and second, with researchers and curriculum developers.

Though the interviews with teachers revealed many positive views about cultural games, participants indicated that their views were developed in isolation and that

professional development opportunities did not occur. Teachers sharing their views with other teachers provide opportunities for colleagues to question, discuss, and interpret the mathematical content and pedagogy of cultural games to ascertain the viability of alternative visions. When teachers publicly share what they are thinking, they are not only learning from each other but are also learning to articulate their ideas, justify their conceptions, and make informed decisions. Teachers' capacity building through sharing their visions as part of a school learning program can be a useful source of craft knowledge base for curriculum implementation. The documentation of craft knowledge in such a program legitimizes the craft knowledge base of games to inform policy and practice.

Improving curriculum implementation also requires communication among teachers, researchers and curriculum developers. While teachers are sharing their views with external agents they are reflecting on their understandings and restructuring their craft knowledge. Such interaction helps the teacher to better articulate their ideas and interpretations and provides valuable information to researchers and curriculum experts. If the concept of indigenous mathematics education is to be pursued with games, teachers sharing their visions with curriculum 'experts' will lead to the documentation of a craft knowledge base for curriculum implementation and teacher development.

## Concluding Remarks

A typical Ghanaian community is endowed with a rich variety of cultural games and playing games is a natural part of the cultural life of the community. The teachers in this study shared their rich personal experiences with cultural games during childhood and adulthood from the communities in which they were raised or now teach. Drawing on these experiences, the teachers expressed thoughtful and diverse opinions as to the purposes and the value of playing games in the community. Unfortunately, this study revealed that little of the rich community life of cultural games makes its way into the classroom. Teachers in this study had limited or no professional development or practical experience with cultural games for teaching mathematics.

I entered the study with the view that cultural games have the potential to promote indigenous mathematics, aid curriculum development, and help children to cross the barriers of learning school mathematics. While most participants seemed to acknowledge the potential value of cultural games as opportunities for learning and teaching, I realized that many of them had never considered using cultural games in the mathematics classroom prior to my interview with them. Most teachers seemed not to have made a formidable link between indigenous mathematics in games and teaching school mathematics as intended by the mathematics curriculum. Through this final chapter I identified some of the obstacles that currently stand in the way of teachers making this connection. I believe that by addressing even a few of these obstacles, inroads can be made and teachers can begin to appreciate the potential of cultural games in the mathematics classroom.

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# APPENDICES

## Appendix A: Survey Questionnaire

**Instructions**

Kindly complete this questionnaire as much as you can. Please respond either by filling in the space provided or by ticking (inside) the box [√] as appropriate. Your honest response will be of great assistance in obtaining valid data for the study of game-based pedagogy in Ghana.

*Note: Spaces were provided for respondents to fill in their responses.*

**Background information**

1. School…
2. Location of school: ..
   Urban community □ Rural community □
3. Class … (4) Number in class …
5. Language of locality ..
6. What is your designation?
   Headteacher □
   Class teacher □
   Subject teacher □
   Others (Specify) ...
7. Your Gender? Male □ Female □
8. Your rank? … Your qualification? ....
9. How long have you been teaching? .....years
10. What primary levels do you teach or have you been teaching?

**Games background information**

11. Where did you live from birth to your early school years?
12. What types of traditional games were played in the community when you were a child (e.g. sand games, etc)?
13. Which games did you play?
14. What did you like most about these games?
15. What did you like least about these games?
16. What traditional games do children currently play in the community you teach?
17. As an adult, what do you think is the purpose of playing these games in the community?
18. Do you think cultural games relate to school mathematics? If so, in what ways?
19. Do you remember using games for learning mathematics in school?
    Yes □ No □
    If yes, at what level (s)?

## Instructional background

20. Do you enjoy teaching mathematics?
    Yes □ Somewhat □ No □
    Why?
21. Have you ever use games to teach mathematics?
    Yes □ No □
    If yes to question 21, then answer questions 22-26. If no, go question 27.
22. What games have you used?
23. What levels have you used the games to teach?
    Lower Primary □ Upper Primary □
24. When was the last time you used a game to teach? What game was it?
25. How was the game used in classroom or learning process?
26) Which game(s) in the school community is/are most important to you for the purpose of mathematics teaching?
27. What are the advantages of using games in teaching mathematics?
28. What are the disadvantages or challenges of using games in teaching mathematics?
29. Do you think children learn mathematics from games?
    Yes □ No □
    If yes, what might children learn from games?
    If no, why do you think so?

## Appendix: B: Participant Consent Form

**University of Alberta**
**Faculty of Education**
**CONSENT FORM**

I understand that I am being invited to participate in a research survey and may also be invited for an informal interview on the use of games in teaching mathematics on the basis that I volunteer.

I clearly understand that I have all the rights to freely withdraw from the study at anytime without any penalty, risk and loss.

The researcher has explained to me in comprehensive terms (orally and in writing) the nature and purpose of the study and how the data or information provided will be utilized.

I understand that I will remain anonymous in the study and that the raw data from survey questionnaires/interviews and resource materials will remain confidential. The researcher promised to use pseudonyms for individuals and schools. The research information will not be used to my disadvantage and that no person other than the researcher, his supervisor, and a transcriber will be the only individuals who will have access to the raw data for 5 years. After this period, the data will be destroyed. Data for all uses will be handled in compliance with the Standards of the University of Alberta and a confidentiality agreement will be signed by the transcriber.

I understand that the data may be used in research articles or presentations to other researchers, educators or for the purpose of training prospective teachers.

Please sign and date your acceptance by making a tick [√] against options below

☐ I **agree** to participate in **both** the research study survey questionnaires and interviews.

☐ I **agree** to participate in **only** the research study survey questionnaires.

☐ I **do not agree** to participate in the research study.

Preferred times for interview .....

Participant's Signature .....Date .....

Contact information:
.....

**For researcher's only**

Signature ..... Date .....

**Contact information:** Michael Nabie Tel: 0244531965/.....
(Ghana)

Lynn McGarvey Tel. 780-492-2436 (Canada)**Letter to the**

**Appendix C: Sample Interview Questions (users)**

| TOPIC | QUESTION | PROBES |
|---|---|---|
| **Teaching Mathematics** | I am interested in hearing your descriptions of activities that take place in your classroom. Could you describe the kinds of activities I would see if I walked into your mathematics lesson.<br><br>How do you try to make mathematics learning interesting and easier to your children? | Teacher discussing with children? Children playing/ working on mathematics?<br><br>Play? Investigating math? |
| **Game Use** | You indicated that you use games to teach mathematics. Can you describe to me the game in your community you frequently use in teaching mathematics?<br><br>Could you describe the activities that might go with this game?<br><br>At what stage during mathematics lesson do you introduce the game? Why?<br><br>How do you introduce the game?<br><br>Describe the role you play when using the game in teaching mathematics?<br><br>Describe the kinds of activities that you let children do during the lesson?<br><br>How do you get children to make connections between the mathematics in the games and the school mathematics? | How special is this game? How is it played?<br><br>Groupwork? Hands-on? Discussions?<br><br>Introduction? Development? Conclusion?<br><br>A story? Demonstration?<br><br>One-and-one demonstration? Group demonstration/ Player? Questioning?<br><br>Groupwork? Out of class demonstrations? |
| | Describe the benefits of these games to you as teacher, your children, and the community?<br><br>Do you have any concerns about using game to teach mathematics? | At the beginning? Selecting a game? Where to play? Now? |

**Appendix C: Sample interview questions (users) Continuous**

| | | |
|---|---|---|
| **Knowledge base** | Can you describe your experiences in professional development, if any, on the use of games as an instructional tool during schooling, practice teaching, and in-service training as a classroom teacher?<br><br>Can you describe what aspects of your professional development are relevant to your needs in using games as a tool for mathematics instruction?<br><br>From your experiences describe the things that foster the use of games in teaching mathematics? | Hands-on activities? Personal demonstrations?<br><br>Classroom conditions? P.D. opportunities? |
| **Gaming Concepts** | Is there any statements regarding the use of games in teaching mathematics in the school mathematics curriculum? Can you tell me what that means to you? | |
| | Describe to me the mathematics children might learn from games?<br><br>How will you know that your children are getting the mathematics of the game? | Counting? Measurement?<br><br>When they voice out/ recite answers/ discuss |
| **Concerns** | What do you like about using games?<br><br>Describe to me your concerns about using cultural games in teaching mathematics? | Availability? Suitability? Accessibility? Space? Misuse? Training? |
| **Conclusions** | Is there anything more you would like to add? | |

**Appendix C: Sample Interview Questions (non-users)**

| TOPIC | QUESTION | PROBES |
|---|---|---|
| **Teaching Mathematics** | I am interested in hearing your descriptions of the activities that take place in your classroom. Could you to describe the kinds of activities I would see if I walked into your mathematics lesson<br><br>How do you try to make mathematics learning interesting and easier to your children? | Teacher discussing with children? Children playing/ working on mathematics?<br><br>Play? Investigating math? |
| **Game Use** | You indicated that you do not use games in mathematics teaching. Why? | Lack of knowledge? Not in the curriculum? |
| | Can you tell me the issues and concerns that might emerge when one is using games to teach mathematics? | |
| **Knowledge base** | Can you describe to me your experiences in professional development activities, if any, on the use of games as an instructional tool during schooling, practice teaching, and in-service training as a classroom teacher?<br><br>Can you tell me what aspects of your professional development would have been necessary to prepare you to use games as a tool for mathematics instruction?<br><br>From your experiences describe the conditions that might foster the use of games in teaching mathematics? | Classroom conditions? P.D. opportunities? |
| **Gaming Concepts** | Is there a statement regarding the use of games in teaching mathematics in the school mathematics curriculum? Can you tell me what that means to you? | In teaching mathematics? |
| | Describe to me the kinds of mathematics might children learn from games? | Counting? Measurement? |
| **Concerns** | Describe to me your concerns about using cultural games to teaching mathematics? | Availability? Suitability? Accessibility? Space? Misuse? Training? |
| **Conclusions** | Is there anything more you would like to add? | |

## Appendix D: Letter to the Municipal Directorate of Education

[5]Department of Elementary Education
551 Education South
University of Alberta
Edmonton, Alberta
Canada, T6G 2G5
..... January 2006

**THE MUNICIPAL DIRECTOR**
**WA MUNICIPAL EDUCATION OFFICE**
**WA, UPPER WEST REGION**
**GHANA**

Dear Sir,

**GAME-BASED PEDAGOGICAL RESEARCH IN MATHEMATICS EDUCATION**

I am hereby applying for permission to conduct a study with primary school teachers who practice in the classroom in the Upper West/Central Region. The study involves teachers' experiences on the use of games as an instructional tool to bridge the home/school gap in learning mathematics in the classroom. The study is a requirement for my Ph.D. programme at the University of Alberta.

The tentative date to conduct this study is from February to May 2006. I believe that the study will provide insight into addressing the issue of using games in mathematics education in Ghana.

I will appreciate it if you could grant my request by the end of January to enable me start on schedule. I would be looking forward to hearing from you as soon as possible.

For further information please contact me in Ghana by telephone at (0244)-531965/ ..... .....or Dr Lynn McGarvey, at lynn.mcgarvey@ualberta.ca or by telephone in Canada at (780)-494-2436.

Thanking you in anticipation for your response.

Yours faithfully,

M. J. Nabie

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[5] This study has been reviewed and approved by the Research Ethics Board of the Facilities of Education and Extension at the University of Alberta. For questions regarding participants rights and ethical conduct of research, contact the Chair of the *Research Ethics Board at (780) 492-3751.*

**Appendix E: Head Teachers of Primary Schools.**

Department of Elementary Education
551 Education South
University of Alberta
Edmonton, Alberta
Canada, T6G 2G5

….. January 2006

The Head Teacher
……
……..
……..
……..

Dear Sir/Madam

I am a graduate student at the University of Alberta, Edmonton, Canada. As part of my study, I am examining teachers' experiences and conceptions on the use of games in mathematics teaching and learning. This will be followed by an informal interview of a small number of selected teachers who will agree to be interviewed. The study results may help understand the challenges of using game-based approach to link home and school in a culturally relevant curriculum.

The participants of the study are teachers at the primary level in the Wa Municipal District of the Upper West. Based on demographic considerations, I have considered your school a suitable site for the study. I would therefore be very grateful if you could allow me to use your school and staff for the study.

For the beginning of the study, I would appreciate it if you could arrange for me to meet you and your staff (for about 5-10 minutes) at your convenience to explain the entire research process.

Your cooperation will be highly appreciated.

Thanking you in advance,

Yours faithfully,

M. J. Nabie.

**Appendix F: Consent Letter for Participation**

Department of Elementary Education
551 Education South
University of Alberta
Edmonton, Alberta
Canada, T6G 2G5

….. January 2006

Dear Teacher,

I am writing to seek your consent to participate in a study on the use of games as an instructional tool. The purpose is to explore if and how games are used in mathematics education in Ghana. The study is part of the requirement for my Ph.D. programme at the University of Alberta, Edmonton, Canada.

Your participation in the study will involve the completion of a survey questionnaire seeking your experiences and conceptions on the use of games during childhood, in school, adulthood, and as a teacher. Your personal experiences and conceptions on games will be treated as confidential. After completing the survey questionnaires, you may be invited to participate in an interview.

The information that you provide will help us understand the nature and challenges of using games in teaching mathematics to inform policy-practice.

Your participation in the study is voluntary. You will have the right to withdraw from the study anytime. I will use pseudonyms so that your identity remains anonymous in the study and that the raw data from interviews and resource materials will be treated as confidential. The information provided will be used for my dissertation. Findings may be disseminated in scholarly journals or used for pre-service teacher development.

Please, indicate whether you will be willing to participate in the study activities identified in the consent form as attached. Among those who will agree to be interviewed, only a small number will be selected.

Thank you.

Sincerely,

M. J. Nabie

**Appendix G: Consent Letter for Interview.**

Department of Elementary Education
551 Education South
University of Alberta
Edmonton, Alberta
Canada, T6G 2G5

..... January 2006

Dear Teacher,

As a follow-up to the survey questionnaires that you completed and on your willingness to be interviewed in the study, I am writing to invite you to participate in the informal conversational interview. The purpose of the interview is to explore further your personal experiences and conceptions relating to the use of games in mathematics education. Your personal experiences will be treated as confidential.
The information that you provide will help us understand the nature and challenges of using games in mathematics to inform policy-practice.

Activities in the interview will be based of your expressed views in the survey questionnaires and will include among others informal conversations:

- about games in mathematics teaching. This may include descriptions, demonstrations, preparations, etc involving games for teaching.
- relating to professional development on the use of games for teaching.

Your participation in the interview is voluntary. You will have the right to withdraw from the study anytime. I will use pseudonyms so that your identity remains anonymous in the study and that the raw data from interviews and resource materials will be treated as confidential. The information provided will be used for my dissertation. Findings may be disseminated in scholarly journals or used for pre-service teacher development.

Thank you.

Sincerely,

M. J. Nabie