

UNDERSTANDING MATHEMATICS TEACHING CULTURE IN RURAL GHANA: A CASE STUDY

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Abstract

Teachers of mathematics have a daily challenge to foster student thinking and reasoning. Maximizing student understanding is a top priority. This ethnographic study sought to understand the culture of teachers of mathematics in rural Ghana. The results indicate that these untrained teachers lacked content and pedagogical knowledge, were faced with a unique student culture, and found ways to overcome all of these obstacles through the effective leadership of their building principal.

Keywords: School-based in-service training, teacher professional development, teaching mathematics, critical thinking, problem solving, rural, Ghana, leadership, school culture

Introduction

Education in Ghana has undergone several reform initiatives since gaining independence in 1957. One of the most aggressive reform efforts started in 1987, extended through the decade of the 1990s and into the 2000s during which time vocational and technical subjects were added, three years were removed from the “education ladder” and improved quality occurred in all levels of education reducing the cultural belief that education must only be available to the elite (Osei, 2006). In 2000, the United Nations General Assembly (UNGA) established eight goals known as the United Nations Millennium Declaration where the third goal clearly declares that every child will have completed primary schooling by the year 2015. This declaration was not unlike the already established 1995 Free and Compulsory Universal Basic Education (FCUBE) reform initiative in Ghana that declared to have all children educated in basic grade one through six by the year 2005. A 20 member committee in 2007 helped establish the latest Ghana education reform initiative that included such things as adding two years of kindergarten and increasing the Free Compulsory Universal Basic Education from 6 to 11 years (Eshun, 2013). Akyeampong (2009) described how FCUBE was unsuccessful in educating all children by 2005 because of factors like poverty.

The World Bank Development Research Group (2014) found that 51.8% of Ghana’s population in 2006 lived on less than \$2 a day. Ghana and the other Sub-Saharan Africa countries have on average 52.3% of their population in 2006 living below the international poverty line and have the largest per capita population of poor residents than any other region on Earth (World Bank, 2014). Poverty defined by income per day is relative. In the United States, a single person living in poverty would make less than \$11,490 (U.S. Department of Health & Human Services, 2013), which comes to about \$44 a day. This is 22 times more money than over half of the population of Ghana. Costs of living in Ghana and the U.S. are very different, but it is suffice to say there are many impoverished people living in Ghana, and Akyeampong (2009) emphasized the challenges of proving free education to children living under these conditions.

Having little income to support oneself or family is daunting and often exacerbated when coupled with isolated living conditions. Poor and rural households in Ghana are additionally disadvantaged because of their remote school locations and larger numbers of dependents living within their less than adequate households (Rolleston, 2011). Nearly 39% of Ghana’s rural population in 2006 lived below the national poverty line (The World Bank, 2014). Ananga (2011) described how many students living in rural areas of Ghana tended to have higher risks of dropping out because of sporadic attendance associated with location and household obligations. Researchers like Dunne and Ananga (2013) illustrated how education at the primary and junior high school levels have unique challenges based on the increasing number of students who start school later in life and educated at the academic level with peers much younger than they, thus increasing the risk of these students dropping out.

Overcoming the challenges of poverty, rurality, and older/academically belated students is the job of many Ghanaian teachers. Osei (2006) stated, “The work of Ghanaian teachers is handicapped by very large class sizes, a dearth of teaching-support resources, long working hours and low pay” (p. 41).

Despite the 2007 educational reform promising additional teacher training and emphasizing the placement of qualified teachers to rural parts of Ghana (Eshun, 2013), teaching in rural areas is not favorable often because of social status (Hedges, 2002). Akyeampong (2003) illustrated how almost three-quarters of Ghana's rural teachers do not have any professional training or teaching experience (cited in Cole, 2011). Hedges (2002) found, however, that these untrained, rural teachers tended to stay in the profession longer than the trained urban teachers. Despite the fact that they may stay in the profession longer, their lack of training coupled with prevailing challenges in rural communities, understanding the culture of rural Ghana educators is imperative.

Teaching Mathematics in Ghana

Ghana's reform initiatives have increased over the last quarter of a century and the country has equally increased its educational spending from 3.3% of the national Gross Domestic Product (GDP) in 1987 to 8.1% in 2011 (The World Bank, 2014). With respect to monetary allocation, Ghana is spending more on education. However, there are areas where even trained teachers are lacking content and pedagogical knowledge. Kwame Akyeampong, Kattie Lussier, John Pryor, and Jo Westbrook (2013) stated that it is "even more critical to acknowledge that the confidence that initial teacher education gives teachers about their apparent competence is not matched by their understanding of teaching as basically problem-solving centered on a deep understanding of children's learning difficulties and ways of addressing them." They found that Ghanaian teachers need better preparation due to their limited understanding of basic reading and mathematical knowledge.

A teacher's knowledge in both the content and pedagogy are essential traits for teachers of mathematics (Shulman, (1987); and Hill & Ball, 2004). Critical-thinking, problem solving, and providing students with rich experiences engaging in the concrete understanding of mathematical concepts are highly important in any mathematics classroom (See for example, Boaler, 2002; Burns, 2007; and O'Connell, 2007). Owu-Ewie (2010) illustrated how student and teacher critical-thinking skills are lacking in Ghana education. Cole (2011) found that when assessing Ghanaian teachers' Mathematical Knowledge for Teaching, the Ghanaian teachers tended to have greater difficulty on measurement items than a U.S. comparison. Akyeampong et al. (2013) stressed the importance of Ghanaian students (both teacher preparation students and those in the classroom) developing an understanding of the mathematics through concrete examples as opposed to the current practice of rote memorization in order to build a better understanding of the content. Agyei and Voogt (2011) found, in addition to Ghanaian teachers of mathematics spending the least amount of instructional time using Information and Communication Technology, that pre-service and in-service teachers used the traditional Chalk & Talk method of instruction most frequently.

Ghanaian teachers of mathematics face many challenges. Their training may not have prepared them adequately or their training was effective but limited facilities and support negatively impacted their implementation of these skills (Akyempong et al., 2013). Teacher training, in-service or pre-service, is designed to better prepare teachers to greatly impact student performance. Part of Ghana's initiative to improve education, they have participated in recent administrations of the international Trends in Mathematics and Science Study (TIMSS) assessment. In 2011, Ghana was ranked last out of over 60 countries in 8th grade mathematics (TIMSS, 2013). This poor performance could be associated with poverty, rurality, or facility factors beyond the influence of teachers, but teacher content and pedagogical knowledge along with effective teaching strategies have been shown to improve student learning and overcome cultural factors such as these (Stemm, 2010). Ampadu (2012) summed up the importance of classroom mathematics teachers when he studied the perceptions of Ghanaian students revealing "that the students' learning is highly influenced by the actions and inactions of the teacher as the teacher controls the students learning experiences by telling them what to do and which method to use" (p. 356).

The purpose of this study was to add to the literature available on Ghanaian teachers of mathematics. This case study took an intimate look into the perceptions of a small set of teachers working in a poor, rural community in Ghana having participated in in-service professional development related to mathematical critical thinking and problem solving. The primary research questions were:

1. What is the essence of being a mathematics teacher in poor, rural Ghana?
2. How does professional development related to problem-solving and critical thinking impact teacher beliefs and practices?

Methodology

This article sought to understand the essence of practicing teachers in one rural Ghana school as they underwent professional development training in the areas of problem solving, critical thinking, and concrete modeling for primary and junior high school mathematics instruction. The researcher is a mathematics education professor from the U.S. who traveled to Ghana to implement a professional development teacher training in a small Ghanaian community in addition to conducting this qualitative, ethnographic study. This ethnographic study utilized structured interviews, semi-structured interviews, observations, and document analysis to understand the culture of mathematics education in this school (Denzin & Lincoln, 2003). Merriam (2002) stated, "Qualitative research is a powerful tool for learning more about our lives and the socio-historical context in which we live" (p. xv). Prior to any data collection, an interview protocol was established providing a guide for conducting an effective interview (Patton, 1990).

Throughout the data collection and analysis phases of this study, constant comparative analysis was utilized (Glaser & Strauss, 1967). As themes emerged from interviews and observations, the researcher solicited greater understanding of those themes as structured and semi-structured interviews were implemented (Merriam, 2002). The researcher finished the initial data collection at the end of the professional development and returned to the school at the end of the first term to conduct member checking (Schwartz-Shea, 2006) and determine how the professional development strategies had been implemented during the term.

Fifteen participating teachers attended and participated in an 8-day professional development workshop. The first full-day training challenged participating teachers to explore instructional methodologies and mathematical challenges geared toward critical thinking and problem solving. Much of the content for the professional development adapted problem-solving tasks culturally adapted from the work of O'Connell (2010) and Burns (2007). The next five days consisted of teacher participants implementing these mathematical tasks with nearly 100 young students from the neighboring town and village each morning and engaging in more professional development in the afternoon. The workshop ended with participating teachers exploring how the mathematical activities implemented during the week would align with their curricula. Overall, the teacher participants received nearly 30 hours of professional development and guided students through learning tasks for almost 20 hours.

The participating teachers in this study were conveniently sampled as they were participating in the professional development provided by the researcher. The school was a private, basic education school whose administrator was a former elementary teacher in the U.S. All teachers were under the age of 30. Six of the participants were male. Eleven of the 15 teachers had completed some type of further education beyond junior high school. Nine of these 11 had continued to earn vocational degree's post junior high school with two completing a university track senior high school. The teachers who only completed junior high school all had similar stories as to why they did not continue their education. One teacher described this reason sharing that "my father fell sick for about one and a half years, so at the end he said he did not have money to take me to the senior high school. So I had to learn the seamstress."

The teacher in this study worked in a rural private school that served over 200 students from Kindergarten through the second year of junior high school. The training workshop was implemented two weeks prior to the start of the first term of the school's second year of existence. Purposeful sampling was conducted following the workshop to select 9 of these teachers for individual structured interviews to obtain a greater understanding of the unique phenomenon of teaching in rural Ghana (Merriam, 2002).

Results

The findings in this study revealed four dominant themes. The first theme centered around the teachers' limited knowledge and understanding of both the content and effective pedagogical strategies, which utilize concrete manipulatives and problem-solving challenges designed to elicit student critical thinking and understanding. The second theme discovered facilities and administrative resources that fostered effective teaching practices. The third theme illustrated how the student and family cultures in this small rural school and community presented challenges that add to

the difficulties in fostering student thinking and engagement. The final theme showcased how the teachers benefited from the professional development and understood the usefulness of the training in challenging student critical thinking and problem solving.

Teacher Challenges

The teachers in this school were not trained and had limited content and pedagogical knowledge. Every teacher interviewed stated they began teaching because they could not find work elsewhere. One teacher summed this up by stating,

“Well, first it was because I needed a job. There was no job [where I wanted] so I had to take it even though I never liked teaching. I never imagined I could teach. So it was something that I didn’t want to do. I never wanted to do, but I had to do it because I needed a job.”

Four of the teachers desired to be journalists and believed this teaching work would earn them enough money to help them go back to school. One teacher said, “I either want to be a teacher or a journalist. I want a platform where I can tell people about what God has done for me. God has really done a lot for me.” The teachers in this school were strongly religious and took many opportunities to share with the researcher how this faith was a catalyst for working in this private school and motivated them to find purpose in their teaching despite their lack in desire to become a teacher following their limited education.

Like Cole (2011) who showed how Ghanaian teachers lacked mathematical knowledge for teaching, this study found teacher content knowledge and the skill of teaching that knowledge to be lacking. A teacher stated, “I struggle with adding fractions and in teaching those kids who do not have the sharp mind.” Another teacher described their limited content knowledge by saying, “I have to read and practice a lot before I come and teach the kids. I am forced to do it.” Like these participants, this study found nearly all of the teachers had difficulties with the content they were expected to teach.

The professional development illustrated to the researcher that improved instruction could not take place until the teachers better understood the mathematics they needed to teach. Most of the teachers knew how to work procedural algorithms but struggled to understand the mathematical concepts governing these algorithms. Because they did not understand the reason why these algorithms worked, they struggled to teach their students in effective ways for them to better understand the procedures. The training focused on base ten arithmetic and strategies of using manipulatives to help students understand the concepts behind procedures like borrowing and carrying. Because the teachers only knew how to teach them the algorithm with no explanation why the procedure works. The teachers experienced limited student recall after classroom instruction focused solely on the algorithm. One teacher illustrated this by stating,

“When it comes to [primary two and primary three], the problem is to teach them how to borrow from one side and then add to another. You give them a problem and they can solve it now. They will go and come tomorrow and you give them the same problem and they cannot solve it.”

This statement shows how the teacher merely understands the procedure as a method of moving a one instead of decomposing a ten from a greater place value.

Without consistent professional development focused on the mathematical concepts and methods of teaching these concepts, these teachers will continue to struggle with effective teaching. This study revealed that this professional development along with the facilities and teacher resources needed to elicit this effective teaching was available to these teachers. After the professional development, a teacher summed up how many of the teachers understood that they needed to be lifelong learners and continue to improve their content and pedagogical knowledge.

“I realized that you learn from them and they learn from you. But mostly, you have to learn to be able to teach them to their understanding. ...It’s the kind of work that you so involve yourself...that you are learning, you are still learning. And you need to learn more to know more.”

Facility and Administrative Resources

A prevailing theme throughout the study encompassed the facility and administrative resources available to the teachers. The researcher visited several schools during the time of the study. Some of these schools were private and many were government run school. The facilities available to teachers in this school were similar to some visited schools but in stark contrast to many others. Each classroom in this school had working electricity complete with an overhead fan, glass-shutter windows, and a door that locked. This was greatly different from some village schools visited that had mud walls, no windows or doors. Many of the participant teachers compared the facilities of this school to other schools they were previously employed or attended as students. Some believed the resources at this school were far superior to those of the school from their past. However, other teachers believed their previous schools had better facilities and resources like library books. The variance in school facilities was evident in both observations and teacher interviews. However, there was very little variance in teacher comments related to the administrator at this school and the effective methods she implemented as an instructional leader on campus.

One teacher described how the resources available to him at this school were similar to those at his previous school but the administrative support was much different.

“I realized that we were having some [materials at my previous school] that we don’t know how to use it. And there was no one to teach how to use it, so the things would be just messed up at the office. ...We don’t know the use of it. But when I came here there are some things that the principal would talk about it. [The principal would say,] ‘This is how you are going to use this.’ And I was somehow impressed.”

The teachers here consistently shared how their administrator was available, supportive, helpful, and always positive. The teachers explained how they could always find support from their principal during their planning, in their implementation, and in their reflection to improve their instruction. One teacher summarized this administrative support by stating,

“Lets say you have a topic to teach and you don’t know how to go about it. When you go to her and tell her, ‘I don’t know how to go about this thing.’ She will sit you down and explain things to you. Help you as to how to teach for the children to understand you better. And she always comes around the class. If there is any help, she helps, and observes the way you are teaching. For me, when she comes to the classroom to observe I become very happy because I know that the work I am doing she appreciates it and so I become very happy. She comes around the class and she sees what is going on and she tries to help every teacher to be able to help the kids.”

The administrator is present and supportive. The teachers appreciate this and these administrative methods have built a community of teachers that see themselves as resources and unified. One teacher describes this saying, “when I am planning [a lesson] and I don’t get it, I ask some of my colleagues...and they help me. ...I think we [teachers] are all united in doing things, and everyone smiles with their friends.” The climate of this school was positive and can be attributed to the leadership of the principal.

Student and Family Culture

Every teacher must address the individual needs of their students. Each student has a home culture that affects the way they learn. One teacher described this student culture by stating,

“Most of the kids, the parents don’t have time for them at the house. Whether homework, the way they dress to school, and all that. The parents don’t care. And so it’s fun sometimes when you talk to [the students] one-on-one and then you get to know some of the problems. They feel at home, and then if possible you can help, try to help some of them.”

Another teacher described how parents believed, “The only thing is them to bring [the students] to the school and the teacher is there to do everything.” A third teacher shared that “Most of [the] parents are not educated so they don’t understand the education. ...For a whole term, [some students] will come to school without a book. Teachers will be using their own money to buy the books for the kids.” The teachers primarily described the parental involvement in this school as limited.

The student culture in this school is governed by parental involvement and societal norms and customs. This community was an agricultural society. One teacher described this community and the challenges it places on students like this.

“Most of the families are farmers. ...We see some of the kids, just after school, ...They are going straight to the farm. They will work on the farm before they come back home with their parents. You expect that child to be very tired. So there is nothing he is going to do about his books. He is just going to relax [when he gets home from the farm].”

This teacher was also raised in a small village like this one. He shared how he would come home from working late in the farm and there would be no light because he father could not afford kerosene. Two of the male teachers shared how they would sporadically attend school because of working either in the farm or elsewhere to help their families. A teacher described how this inconsistent attendance is also prevalent at this school stating, “Some of the [kids] come twice a week. Some come once in a week. ...When they come, it is delaying the work of the teachers because ...[g]etting back to explain all of these things to them takes a lot of time.” The students are working late and not attending to their schoolwork and some seldom attend school because of their agricultural culture.

Critical Thinking and Problem Solving

The final theme in this study illustrated the teachers' perceptions of critical thinking and problem solving within the context of the professional development. Concrete manipulatives were utilized during the teacher training and student implementation phases of this professional development. The teachers were engaged in critical thinking and problem solving activities that they then implemented with students the following day. The teachers and students were rotated through four stations each morning challenging them to complete mathematical tasks within and outside of the classroom. One teacher described the benefits of this training by stating,

“Because of the manipulatives we use and the way we rotated and the way we went out to the farm, to the field, it really helped [the students] to enjoy learning maths. Sitting at one place every day doing the same thing, its kind of boring, but when we went out and rotated, it got them very active and involved. They wanted to do [the mathematics].”

Another teacher shared how his older students started the activity with pentominoes (a mathematics manipulative used to explore perimeter and area) saying, “Some of the [older students would say] ‘These are for kids.’ Some would say ‘Are we children? Are we coming to do these small small things?’ I tell them, ‘You just wait. When we start, you will know what it is about.’” The teacher continued to describe how the students had gained a greater appreciation for the manipulative saying, “The same person came back the following day and said, ‘That thing...it was on the pentominoes, that we join, join, join. That thing was hard!’”

Several teachers described how the training was beneficial and they could see how the concepts can help students better understand the mathematics they are learning. Many teachers shared how they struggled with certain teaching concepts and the training helped them better understand both the content and how to teach it. One teacher shared after working with Base 10 Blocks and the addition and subtraction of whole numbers that:

“I have learned a lot from the training. Previously I have been finding it difficult, even though I have been doing my best to teach shapes, additions, and especially with the borrowing and carrying. I was really happy how you showed us that one. Sometimes I say that I'll be teaching the thing and the children are not getting why I carried it. They keep asking, asking, asking questions. In my own way, I find my way of explaining it, but what you did was the best way to explain it to them.”

By the end of the training, the teachers illustrated a sincere desire to improve their teaching by improving their own knowledge in critical thinking and problem solving. One teacher summarized this by stating, “When I came here, when you were teaching, I realized that there is much that I don't know, much that I need to learn.”

Conclusions

Studies like that of Owu-Ewie (2010) and Akyeampong et al (2013) highlighted the shortage of qualified and trained teachers of mathematics in Ghana. This case study found teachers to not have formal training in a post secondary institution, but this did not limit their ability to explore, implement, and understand the importance of nontraditional instructional methods centered on mathematical critical thinking and problem solving. The teachers had limited professional education but were surrounded by a plethora of resources, an involved instructional leader as a principal, and a positive demeanor towards challenging student thinking despite negative family and community influences. There were two research questions in this study. One investigated the essence of being a mathematics teacher in rural Ghana and the other addressed what perceptions these teachers had about the implemented professional development.

The essence of these rural Ghanaian teachers of mathematics hinged on the instructional leadership of the principal. The teachers lacked knowledge, but the instructional leader provide guidance and resources to help teachers overcome these limitations. The students brought challenges, but the teachers described how the principal inspired communication with parents and aided in that communication between teacher and parent. The teachers proclaimed benefits from this professional development and the routine trainings the principal instigates on a regular basis. The teachers possessed a belief that knowledge not known could be learned and their principal could help. They believed in improving themselves to improve the learning of their students. They had a belief that what the students' families could not provide, they could provide. The teachers also had a belief that challenging students critical thinking and problem solving skills with concrete manipulatives could help students have a better understanding of mathematics.

Much can be learned from this case study pertaining to professional implications. Akyeampong (2003) found the majority of rural teachers are not trained and this study validates that claim. Centers for professional development distributed across the rural landscape of Ghana could provide untrained teachers in these communities a resource to improve their instruction. Training for school principals in these rural areas focused on being an instructional leader as opposed to a disciplinarian could also help improve the climate of rural schools across Ghana. There is no solution that will work for all schools across rural Ghana, but this study illustrated that with strong leadership and a teaching environment that fosters growth and collaboration, student learning can effectively take place.

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