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A study on an integrated mathematics and art curriculum for fifth grade second language learners

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**A STUDY ON AN INTEGRATED MATHEMATICS AND ART CURRICULUM
FOR FIFTH GRADE SECOND LANGUAGE LEARNERS**

**A Thesis
Presented to
The Faculty of the Division of Teacher Education
San Jose State University**

**In Partial Fulfillment
of The Requirements for the Degree
Master of Arts**

**by
Rocio McCoy
May 1996**

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ABSTRACT

A STUDY ON AN INTEGRATED MATHEMATICS AND ART CURRICULUM FOR FIFTH GRADE SECOND LANGUAGE LEARNERS

by Rocio McCoy

This thesis addresses the study and implementation of an integrated mathematics and art curriculum in a fifth grade bilingual class at Cèsar Chàvez Elementary School. In addition, the results from students working together with the teacher as co-researchers are also studied. The outcome and the results achieved through this partnership are reviewed throughout the study including the designing and painting of the final project, a mural.

This research revealed that this was a positive experience for students and teacher. Together they developed several experimental art and fraction activities. From one of these activities, students chose the theme for the mural. Fractions and art were integrated during the planning, designing, and painting of the mural. The data collected from discussions and students' work showed evidence that students not only improved their knowledge of fractions and art but became more self-confident.

ACKNOWLEDGMENT

In the text of this work I talk extensively about the many difficulties I encountered as a second language learner. There is little information, however, about the people that helped me throughout the years. I would like to thank my parents because it was their trust in me that kept me going even through the most difficult times. Especially towards the end, my stepfather gave me support and love. He flew to San Jose to see me walk and be hooded, arguing that "No matter how sick I am, I am going to attend your graduation, even if this is the last thing I do." Little did we know, but he was right. A short time after the graduation ceremony he passed away, but his love stayed with me. Thanks, Dad.

My husband, Mark, and my children, Alexandra and Michael, were there for me when I needed them. Mark became my editor and spent many hours reading information that was, in many instances, unrelated to his work or training. Even through the most difficult times I always felt Mark's unconditional support. I also want to thank my daughter Alexandra who always greeted me with a smile, even after spending many hours helping me with chores around the house and who was so patient and understanding. As for Michael, he grew up believing that mothers "study all the time."

I would also like to thank Dr. Victoria Harper,

Dr. Roberta Ahlquist and Dr. Carolyn Nelson for all their advice and support. I would specially like to thank Dr. Harper, who has been my professor, my advisor, and a friend who gave me courage and trust during the last and most difficult years in college. A thousand words would never be enough to describe the gratitude I feel for her, and I hope some day I will be able to be as dedicated and loyal to my students as she has been to me.

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PREFACE

I have always heard about writer's block but have never experienced one until I was asked to write this thesis. Three and a half hours after I had started typing I had written four meaningless sentences. The only thing I did during this time was to stare at the computer screen thinking about how I was going to complete this work. I had decided to conduct a qualitative study focused on the integration of a mathematics, art and culture project I implemented in my own fifth grade classroom. The understanding I had about what "real research" was, however, obstructed my ability to think for several reasons. First, I had heard that one should never write using the first person. Having first encountered research as a student in a quantitative research seminar, I was prepared to use the term researcher instead of the first person. A question however, kept coming to my mind. How could I write about something so personal without using the first person?

Second, based on my own understanding about research I believed that the thesis had to be divided into specific chapters with set titles. I felt that I was expected to take all the data collected during the study and force it into the format of the paper. This became one of the most difficult tasks I have experienced. I felt that I had to sacrifice valuable information and meaning in order to

follow the traditional format.

I encountered an additional obstacle when a professor, teaching the traditional research class, announced to the class that students, whose first language was not English, needed to seek professional help because their writing was not at graduate level. I felt embarrassed because everyone knew that I was the only second language learner in the class. After this, I felt powerless and less willing to continue writing. I was experiencing a difficult time writing, not because English was my second language, but because of the constraints put upon me by a traditional research doctrine that limited my thinking, sacrificed creativity, and the researcher's and participants' voice, in the name of making my research objective, "neutral" and scientific.

As I worked with the research process and data, it was clear to me that the traditional model for research was inhibiting my ability to express meaning and to share the excitement of my project. The qualitative approach, on the other hand, provided me with the opportunity to be a participant in my own study. This was important to me because I wanted to work as close to my students and their work as possible. I believe that by doing this, my students and I were able to share important experiences and emotions that would have been otherwise ignored in the name of

objectivity.

As a way to demonstrate the differences in perspective from my initial work and my reflections on that work, I am including sections titled **Reflections** throughout the text that provide reflective perspectives about the research process and what I learned in the course of the project.

CHAPTER ONE

SEEING MYSELF IN THE RESEARCH

My interest in second language learners emerged from my own experience as a foreign student in high school. When I arrived in the United States in 1972 from my native country, Colombia, I encountered many difficulties including adapting to the new environment, learning a new language, and conforming to a new educational system.

Watching the snow fall in December always brings sad memories of my childhood experiences as a second language learner. In 1971 during my junior year in high school my mother announced that she and my stepfather had decided to send my sister and me to finish high school in the United States. Arguing that our English language skills were limited, my parents felt it was necessary for us to improve them. In Bogotá, Colombia, entrance into most universities requires passing a basic reading and oral English proficiency examination. Knowing that I was not English proficient, I agreed with them and made plans to come to the United States to finish my high school education. I was very happy to have an opportunity to study in a foreign country. I did not, however, realize that I was about to encounter many difficulties in learning this new language and adapting to a new culture.

My sister and I were enrolled in Friends High School, a

Quaker boarding school, in Barnsville, Ohio, for the spring semester of 1972. The school was over one hundred years old and had never admitted a foreign student. The only Spanish speakers in the school were the Spanish teacher, my sister and I. I was not allowed to speak Spanish to either one. The counselor recommended that my sister and I be separated to prevent us from speaking Spanish, believing it would be the fastest and most efficient way for us to learn English. Following the counselor's recommendation, we were placed in different classes and assigned to different dormitories. In this way they could be sure we would not ever speak Spanish. At first, the counselor's recommendation seemed reasonable and logical. As the days and months passed however, I became more and more depressed. Not being allowed to speak to the only people who understood me made me miss my family and my friends even more.

Furthermore, I did not like the food. Having been brought up Catholic, I knew little about the Quaker religion. I ate very little and lost weight. I did not speak to many people because they ridiculed my limited English. I wanted to learn more about the Quaker religion, but the only religion class we had was Bible study which I understood even less than other subjects because it was taught in biblical English. My teachers were kind and tried to help my sister and me as much as they could, but I felt I needed time. Time, however, was

the one thing no one gave me. I was expected to complete my senior academic requirements successfully in a foreign language in one year. The more I thought about this, the worse I felt. I kept thinking, "One year is not enough." One year is not enough to develop sufficient vocabulary and language skills to master the academic subjects of chemistry, mathematics, social studies, and religion.

Time was my worst enemy except in my art class. I enjoyed every minute of that class. I was not constrained by language and was free to create what I wanted. I worked whenever I could. My drawings and paintings became my most inner, solitary, and only form of communication. In art class I was just another student and that was all I wanted to be.

One late afternoon in November of 1972, I went to my room depressed and tired. I had been up most of the night, studying for a social studies test, trying to comprehend what I was reading. I had to read each sentence several times looking up one-third of the words in a dictionary before I could draw meaning from what I was reading. This process usually took many hours of extra work. My days were never long enough for me to study. I often broke school rules in order to study. At night, when everyone was asleep, I would slip out of my room and go to a small study room on the first floor of my dormitory. Afraid of being caught, I had no other options; either stayed up and studied or I would fail my

senior year. After taking that social studies test, my teacher asked permission to read a section from my test to the other students. I agreed, feeling confident about my test results. As the teacher read my test the students started to giggle and soon they were laughing. The entire class was laughing and I did not know what they were laughing about. My teacher then handed me the test, leaving me without any understanding of what had just happened.

Returning to my room, the only place I considered to be safe at that time, I was upset. More than ever, I felt completely lost. Not quite understanding what people said or what I was reading, I did not know what was so funny to my peers and teacher. In Colombia I had friends who understood me and who I understood. Books were written in Spanish. I did well in school. In the United States I did not feel smart anymore. I felt ignorant with much to learn about the language, culture, and religion of my new school.

I sat down on the edge of my bed, thinking about all the things that had happened to me that day; I looked out my bedroom window and saw small white snowflakes falling from the sky. It looked so beautiful that I could not stop looking. Soon the small country hills around our boarding school lost their golden brown color and turned sparkling white. I was mesmerized by the beauty of this winter day. I realized then that I had not seen snow for eleven years, the last time I had

seen my father.

In 1961 my family moved to Montreal, Canada, from Colombia because my father was finishing a specialization as a neurosurgeon. One year later, my father told my mother to return to Colombia with my two brothers, my sister, and myself because he had decided to join the Communist Party. He said, "Where I am going you are not allowed to be." Believing that oppressed people in South America needed to be liberated from their oppressors, he thought that it was up to those with higher education to do it. Talking to me he said, "You are not the only daughter I have. All poor children in the world are my children as well." I did not understand what he meant. I only remember feeling the pain of losing a loving father.

Granting my father's wish, but destroyed, for she loved my father very dearly, my mother took her family and went back to Colombia. My mother struggled as a single mother of four trying to work and support our family. My father moved to Cuba to collaborate with Fidel Castro during the invasion at the Bay of Pigs in April 1961. After he left Cuba, he lived in France, and then Russia, where he had the opportunity to write several books which were published in different languages. He did not return to South America until years later, traveling to different countries using different surnames in order to protect himself from the Colombian and American governments.

During this time we knew very little about my father. On a few occasions we saw his name in the city newspapers. It was his desire to become a strong and appreciated member of the revolutionary and guerilla groups in Colombia. I met many people who had, at one time or another, known my father. One man told me that my father had removed a bullet from his leg and that he was very thankful. Another woman admired him because he had saved her dying daughter. My father was well known as a doctor, not only because of his skills as a competent surgeon, but because of his relationship with his patients. He was happy with a bag of oranges, a chicken or any other thing people could give him as compensation for his services.

His work was not appreciated by the government. Because of this he went into hiding and no one seemed to know his whereabouts. His dream to help those in need ended in December 1972, when he was captured and assassinated in Quito, Ecuador, by Ecuadorian military police and the American Central Intelligence Agency (CIA).

After this tragedy I felt that there was nothing for me to live for. I felt destroyed. My father had been my idol. My love for him was immense. He was extremely intelligent. He was a doctor who had written books in different languages. He had done good things for poor people in Colombia and other South American countries. I admired him yet could not

understand him as a father. As a little girl I believed that if I was good he would come back. He never did. I wondered what I had done that was so wrong that it made him leave. Even today I can not completely understand his decision to leave his family. I have, however, come to realize it was not because of me that he left.

Later, my mother married a wonderful man who became our friend and father. He was an American engineer working for an oil company in Colombia. Our family began to speak English at home again. I had forgotten most of the English I learned as a child in Canada. It was at this time that my parents decided to send me to the United States to complete high school thinking this would be the best way to improve my English. At the boarding school, however, I asked myself every day why it had to be so difficult? Was there another way I could have learned English without losing my self-esteem?

Since I could not ask these questions of anyone else, I decided that it was up to me to find the answers. Leaving my room, I went to my social studies teacher and told her that I had no idea what was so funny about my test and why everyone laughed so much. She explained to me I had said that World War II had affected the electricity in Europe. At this point I realized that I had confused the word electricity with currency. In Spanish these two words are synonyms.

Electricidad and *corriente* both mean electricity in Spanish, and when studying I did feel that it was strange that the electricity had anything to do with World War II. Since this word was in the book I thought "It must be true," and I memorized it as I did everything else. The day of the test I could not remember the word currency so I chose electricity, believing I was making a good decision since the two words are interchangeable in Spanish. When I left the social studies room I felt somewhat better. I was able to see how my mistake might have seemed funny to others.

I continued to sneak out of my bedroom almost every night to go to the study room. I had learned to laugh with others when I made mistakes. As my grades improved my self-esteem increased. As my English improved, I felt more open to people and found many friends.

Although I felt better about my relationship with others and about myself, I was right in thinking that one year was not enough to really learn English. Following high school I entered college in San Diego, California. There I continued to struggle as a second language learner at a much higher intellectual level. I developed oral skills rather quickly, but to become a confident reader and writer of English it took more than seven years.

Today as a bilingual teacher, I can easily identify with my students. Many of them are immigrants who came to this

country because their parents wanted to see them succeed. Unaware of the adversities they might face, they arrive full of hope. In time, however, they lose interest in school. This happened to me. I felt so depressed and confused, thinking that graduating from high school was an impossible goal. Many second language learners share this feeling; school is an overwhelming experience where they feel it is impossible to succeed. Isolated not only during class time, but often outside of class as well, they find it difficult to make friends because they can not communicate.

My experiences as a second language learner have led me to place value on four areas of emphasis in my classroom. First, art was helpful to me because I believed it could be used to help second language learners feel more comfortable in class and less alienated from their peers. In the lonely days when I lived in the Quaker boarding school I did not have the language skills to communicate. Art became my only form of discourse. Based on these experiences, I include art as an important part of my curriculum not only to help increase students' self-esteem but also their academic understanding. Art activities provide a context where second language students can feel successful and safe.

Second, I was able to earn a college degree because my family was very supportive, I was determined to do so, and I had the help of many dedicated teachers. Second language

learners need these elements to succeed. Students need role models at home that will teach them to value education. I remember my father studying and reading almost every night. My mother spent many hours talking to us about the importance of education. "To succeed you need education," my mother used to tell us. My parents' trust in me and their appreciation for education kept me going even through the most difficult times. I would have done anything to avoid disappointing my mother. It was my parents' support and love that made me want to succeed.

Third, I met a few teachers who were willing to take the time to work with me, teachers who believed in me and supported my self-esteem so I could continue. Educators together with parents can make this happen. Educators need to work together with parents to help second language learners adapt to their new environment without jeopardizing the students' self-respect (Nieto, 1992).

Fourth, I learned that second language learners acquire English more comprehensively in a safe environment and through meaningful experiences. They need to feel comfortable taking risks while learning English. It is also necessary to provide a multicultural curriculum design with themes and activities which are relevant to the students' own experiences.

The four areas of emphasis described in the above section are congruent with Cummins' (1989) four guidelines for

integrated multicultural curriculum. First, Cummins (1989) believes that the language and culture of minority students should be incorporated in the schools. Second, he suggests that culturally diverse families need to participate actively in their children's education. Third, he proposes that students be motivated and guided so that they can "generate their own knowledge" (p. 32). Fourth, he recommends that assessment be regarded as an opportunity to find out what difficulties are being encountered in meeting the academic needs of students.

Second Language Learners Adapting to a New Environment

Wallerstein (1983) agrees with Cummins (1989) and points out that ethnically and linguistically diverse students have a difficult time adjusting to the mainstream educational system because concepts taught in schools are unrelated to their home environments. Freire's (1970) experience in Brazil, while teaching literacy programs to rural peasants, has shown that students' previous knowledge and interests are an important element in successful educational programs.

Although some subjects have been integrated and designed to meet the needs of ethnically diverse classrooms, there have been very few studies done integrating art and mathematics in a multicultural curriculum.

In order to consider these issues, a fifth grade class of Mexican and Mexican-American students at Cèsar Chàvez

Elementary School was selected for this study. This school has a ninety seven percent ethnically and linguistically diverse student population. In 1993, the students at this school tested below the fiftieth percentile on the Stanford Achievement Test (SAT). These fifth grade students received the lowest scores in the school; they ranked in the thirty sixth percentile. These scores often are considered to be an indication that the curriculum or methodology used has not met the academic needs of these students. Cummins (1989) argues, however, that many times assessments can be biased against the minority student. He believes that minority students have a better opportunity to succeed when "instructional tasks are expressive of the children's own experience rather than when they are teacher-imposed" (p. 66).

Focus of the Study

This study was conducted to determine whether such an integration of multicultural studies (Mexican culture), mathematics (fractions), and culturally oriented art (murals) curriculum could enhance fifth grade Mexican-American and Mexican immigrant students' understanding of mathematics, art, and their own culture.

Multicultural Approach to Education

According to Nieto (1992), multicultural curriculum is provided through the following means:

It is a process of comprehensive and basic education for

all students. Multicultural education challenges and rejects racism and other forms of discrimination in schools and society and accepts and affirms the pluralism (ethnic, racial, linguistic, religious, economic, gender, etc.) that students, their communities, and teachers represent. (p. 307)

Nieto contends that multicultural education should permeate the curriculum and instructional strategies used in schools. It must be evident in interactions among teachers, students, parents, and in the way schools conceptualize the nature of teaching and learning.

RESEARCH QUESTION

In order to look at this issue I decided to engage students in the study of Mexican culture through a multicultural curriculum that included mathematics and art. In order to personalize their study I arranged to develop with the class an exterior building wall size mural which required that students learn skills in painting and design as well as mathematics, particularly fractions.

Through careful documentation of this integrated project over the period of an entire academic year (1994-1995), I was able to gain a greater insight not only into the learning process experienced by my students, but also into what incidental learnings emerged during the research. The following research question guided my study:

How do students' exposure and interest in a culturally significant integrated study of mathematics, art and Mexican culture enhance their interest and understanding and pride in their ethnic heritage and of mathematics?

CHAPTER SUMMARY

The increasing numbers of ethnically and linguistically diverse students entering California's schools each year challenge educators and researchers to create curricula suitable for the needs of these students. This study was conducted in San Jose, California, at Cèsar Chàvez Elementary School. This study examines how an integrated mathematics and art curriculum can enable Mexican and Mexican-American students become informed about mathematical concepts related to the understanding of fractions as they learn about Mexican cultural traditions of art (muralist) and mathematics (Aztecs and Mayan culture). In addition, this project was designed to assist students, parents, and teachers in providing an opportunity to build a partnership where the adults could "model authentic and positive learning behaviors" (McCaleb, 1994, p. 25).

Reflections

This introduction was written at a time when I had already freed myself from traditional writing formats. The qualitative participatory research approach provided me with the opportunity to look into my inner feelings and to bring these experiences to a consciousness level. Drawing upon these memories, I was able to construct a parallel between my own experiences and those of my students, thus situating me as a participant as well as a co-researcher in my own study.

CHAPTER TWO

REVIEW OF THE LITERATURE

Summary of the Problem

This study was conducted in view of the fact that culturally and linguistically diverse students in California are scoring far below their Anglo peers in mathematics. It was the purpose of this study to implement an integrated multicultural mathematics and art curriculum in order to improve mathematics and art knowledge among bilingual fifth grade students at Cèsar Chàvez Elementary School.

Throughout history, the United States has distinguished itself from other countries by its acceptance of great numbers of immigrants who arrived in this country every year. According to Lessow-Hurley (1990), during the nineteenth and twentieth centuries, large groups of European and Asian immigrants settled in the United States. In 1910 large groups of Mexicans moved to California following the Mexican Revolution. For many years people continued to immigrate to the United States until two new immigration acts were passed. The first, the 1917 Immigration Act, "excluded" Asians. The 1924 Immigration Act allocated an immigration quota to all countries located outside of the Western Hemisphere.

More recently, in 1965, immigration policy in the United States was changed by President Lyndon B. Johnson (Lessow-Hurley, 1990). The Johnson immigration policy

limited immigration to 20,000 per country. Before this, immigration policy favored those groups who were highly represented among the population in the United States. Because of this policy, enormous numbers from all over the world immigrated each year. Lessow-Hurley (1990) found that in 1984 alone, 600,000 legal immigrants entered this country.

This continuous inflow of immigrants has influenced the United States, and California in particular, politically, socially, economically, and educationally. California's educational system, for example, has not been able to change fast enough to meet the needs of second language learners and other culturally diverse students.

The United States General Accounting Office estimated that there were 1,515,406 second language learners in the United States during the 1985-86 school year. During the same year California had 567,564 second language learners representing the largest concentration in the country (Lessow-Hurley, 1990). The California State Department of Education reported that in March 1993 there were 1,151,819 second language learners in California. These figures indicate that during the last seven years the number of second language learners entering schools in California increased by 584,255. According to Olson (1988) an ethnically diverse student population in California will continue to increase steadily as shown in figure one.

California's School Age Population by Ethnicity

Figure I
17

By the year 2000, an estimated thirty-four percent of students under the age of eighteen in the United States will be of Asian, Hispanic, Afro-American ethnic origin, or represent other ethnically diverse groups (Daniel, 1990). California is experiencing one of the largest ethnically diverse student population increases of all fifty states. The California Department of Education indicates that no one group forms a majority in California. This is evident in its latest demographic report (1994). This report provides a statistical breakdown of minority students in California as follows :

1. Asians.....432,140 or 8.2%
2. Hispanic.....1,951,578 or 37.1%
3. Afro-Americans.....455,954 or 8.7%
4. Filipino.....126,878 or 2.4%

Educators are confronted with the difficult task of creating curricula that can appropriately meet the needs of this diverse student population.

Language Culture and Curriculum for Second Language Learners

Such diversity created by immigration confronts teachers and schools with common challenges in making curricula meaningful and relevant to second language students. To meet the needs of California's diverse student population, Olson (1988) recommends that schools adopt a

multicultural curriculum in which students' ethnicity and background is incorporated into lessons and in which the students' language and culture are viewed as an asset and not as a deficit or barrier. Nieto (1992), identifies several studies illustrating how students who maintain their language and culture by resisting assimilation tend to do better at school. She cites a study done with Punjabi students who, constantly reminded by their parents about the importance of maintaining their own values and culture, did better at school than those who assimilated "the values and behaviors of their majority peers" (P.234).

The idea that assimilation is an important factor for students' success has been contested by many researchers. Olson (1988) suggests that student diversity be viewed as a tool to build connections between students of different backgrounds and not as a barrier. Peregoy and Boyle (1993) describe this link between diverse students as a "rich tapestry of languages and cultures that form the basic fabric of the United States" (p. 3).

This project was conducted based on the thinking of a number of education theorists who argue that students' language and culture need to be incorporated into educational plans of schools (Delgado-Gaitan, 1990; Doll 1993; and Freire, 1970). To address this issue Cummins (1989) generated the following four guidelines for the development of integrated curriculum for second language

learners:

1. Language and culture of minority students should be incorporated in the schools.
2. Students should be motivated and guided to construct their own knowledge.
3. Parents should actively participate in the designing of the curriculum.
4. Assessments should be made as an opportunity to find out what difficulties the school is encountering to meet the needs of the students and not as the measurement to identify the academic difficulties of the students.

Enright and McCloskey (1988) argue that when second language learners enter a classroom in the United States, they are immediately exposed to a culture and language foreign to them. Culture, as described by Peregoy and Boyle (1993), is formed by shared beliefs, values, and behavioral patterns among a distinct group. According to Lessow-Hurley (1990), second language learners must adjust to simple everyday routines at school such as schedules, bells, food, social events, and other school activities. These everyday routines might be simple for majority students, but they can differ markedly from many second language learners' previous experiences.

Peregoy and Boyle (1993) estimate that it takes six months after arriving from another country for students to be able to communicate with friends and repeat very simple messages in English. In addition, Cummins (1989) found that second language learners acquire conversational skills much sooner than academic skills. Reporting a study done with

2,000 limited-proficient students in an upper-middle class suburban district, Cummins (1989) claims that it took students an average of four to nine years to obtain a "native like" academic level in English (p. 27).

Peregoy and Boyle (1993), recommend that in order to help second language learners and ethnically diverse students adapt to a new culture and new language, lessons need to be meaningful to the students. They found that students, regardless of their ethnic background, enjoyed lessons that included references related to the students' own culture. These references helped students look at their own background, making lessons more interesting and enjoyable to them, and indicated to them that their cultures were valued.

By "bringing the new world directly into the classroom," Enright and McCloskey (1988, p. 210) mean that teachers need to view field trips, school tours, speakers from the community, and other activities as a way of integrating the curriculum. Enright and McCloskey (1988) argue that these activities benefit second language learners because they help students adjust to their new environment (p. 210). The authors defined the integrated classroom as follows:

The integrated classroom community is not an island. Rather, it is firmly situated within the larger language and culture. The teacher selects parts of that larger language and culture to use in the classroom to forge the multicultural community ties that will further support language and literacy

development. (Enright, McCloskey, 1988, p. 212)

According to Daniel (1990), integrating subjects helps students understand and relate to the material being taught. This method also helps students see different realities of the world while, at the same time, giving them opportunities to share aspects of their own culture with others.

Christison and Bassano (1981), while investigating subject integration, conducted a study with second language learners which integrated language and art. They found students were able to express feelings and emotions through drawings in ways often impossible for them to do through language.

In addition to adjusting the curriculum for ethnically diverse students, Pérez and Guzman (1992) also recommend educators view parents as a valuable resource. According to McCaleb (1994), not only can parents help teachers design a culturally rich curriculum, but together they can help students acquire a more "positive-self identity" (p. 41). Pérez and Guzman (1992) state that parents are children's first teachers. Children spend many hours each day sharing different activities with their parents such as singing songs, cooking, drawing, and other informal activities. Pérez and Guzman (1992) believe that "parents are bearers of culture and sources of knowledge that classroom teachers often ignore" (p. 176). However, parents and teachers can work together to help bring the community into the classroom in many ways. They can bring in speakers, share important

information about the social events of the community, and support parent participation in school and classroom events. Through all these activities cultural and community knowledge can be incorporated into the educational plan. As a result students feel their identity is being valued thus increasing their self-esteem.

As mentioned in Cummin's (1989) earlier recommendation for an integrated curriculum, assessments are needed to evaluate students needs and not simply their lack of academic knowledge. Puckett (1994) argues that, in most schools, students are assessed only to measure academic difficulties, claiming that in the 1986-1987 school year "105 million standardized tests or test batteries were administered to 39.8 million elementary and secondary public school students" (p. 6). Standardized tests are mainly used to separate students among categories such as "slow learners" and "accelerated learners" (Puckett, 1994, p. 6). These tests not only categorize students according to numerical scores but have been found to be culturally biased. Informal observations and tests designed for a specific student population are considered a more reliable form of assessing ethnically diverse students than standardized tests (Pèrez and Guzman 1992).

Post-Modern Curriculum for Second Language Learners

Cummins' ideas will be used as the main guideline for this study. However, Doll's (1993) suggestions for the

creation of a post-modern curriculum will be considered as a method of improving instruction. Doll (1993) states that science, based on new findings in physics and biology, has taken a new position moving "from a premier position within a closed system where is methodology dominated, to a more equitable position among many methodologies in an open system" (P. 3). Our thinking about curriculum has been based on an older paradigm, a closed linear system. Doll (1993) suggests we create a curriculum based on post-modern thinking and open systems. In such a curriculum the relationship between teacher and student changes. Under the modernist paradigm, teaching was often based on a teacher-centered classroom. A post-modern perspective on the curriculum, however, requires the teacher and students to be considered as a community of individuals who explore and reveal issues together. Students are viewed as "active creators of knowledge instead of passive receivers" (Doll, 1993, p. 175). To do this, Doll (1993) suggests four R's for successful instruction. The four R's consist of "richness, recursion, relations and rigor" (p. 176).

A curriculum needs to be rich, according to Doll, (1993) which means it needs to be flexible enough to allow for multiple interpretations or possibilities. Recursion is promoting the ability to organize, to combine, to investigate, and to heuristically use something. Recursion does not have a set frame but is something that is open for

reflection. This is not repetition. It allows thoughts to come back so that you can reflect on past experiences. According to Freire (1970) reflexion allows an individual to see greater possibilities of being. The third R, relations, is divided by Doll (1993) into two parts, pedagogical relations and cultural relations. The former is considered to be the relations that can be formed between students and the material studied in class. The material read is used to help students find connections among themselves or among other readings (Shor, 1980; Doll, 1993; and Freire, 1970). Cultural relations is the connection between students' cultures and other cultures. Rigor is considered by Doll (1993) to be one of the most important of the four R's. He believes that rigor "keeps a transformative curriculum from falling into either rampant relativism or sentimental solipsism" (p. 181). By this Doll means a curriculum that allows students to rigorously look for new combinations, interpretations and patterns.

Mathematics Curriculum for Ethnically Diverse Students

The section on whole numbers and fractions from The California Mathematics Framework (1989) and the findings of several researchers were used as references for this study. Among these were Gheverghese's (1993) who states that mathematics is believed by many teachers to be a multicultural subject since most countries use the same numerical symbols. He believes that even though the same

numerical symbols are used by different cultures, however, is not enough to say that mathematics has few language barriers. Most cultures create mathematical concepts of their own, in the same way they may create a variety of languages, religions or political organizations.

Cocking and Chipman (1988) believe that most cultures view the study of mathematics in a different way. They point out that many Hispanic and Native American parents view mathematics as a subject that is mainly for boys. According to these researchers, Hispanics and Native Americans often do not encourage their daughters to pursue careers in mathematics because "this discipline is associated with qualities that are undesirable to the cultures" (p. 36).

Hispanic students are encountering other obstacles that affect their success in mathematics. Based on the mathematical scores from the National Center of Educational Statistics in 1978, Cocking and Chipman (1988) argued that Hispanic students were scoring below their Anglo peers. These researchers learned that Hispanic students were having difficulties with knowledge and skills, mathematics understanding, and application.

Educators complain that second language learners sometimes have a difficult time understanding simple mathematical concepts. According to Engelman (1991), when teaching new concepts it is important to consider the

students' schemata or previous knowledge. Piaget (1990) describes scheme as "an organized pattern of behavior or thought" (p. 59). Engelman (1991) and Piaget (1990) argue that in order to make mathematics comprehensible to students, educators need to use students' previous knowledge or schemata as links between previous knowledge and new concepts being taught.

Based on a post-modernist view, Doll (1989) also feels that it is unfortunate that educators in America have paid more attention to Piaget's developmental stages than to how people move from one stage to the other. In Doll's recent study Complexity in the Classroom (1989) he found that students learn mathematics in a nonlinear way. He and his partner gave sixth grade students mathematical problems that provided them with the opportunity to be creative and productive at the same time. All of the problems not only had a high degree of randomness but the patterns were not predictable. At first students experienced what Doll (1989) refers to as "mathematical chaos" (p. 66). He found that within that chaos there was a pattern embedded with order. Allowing students to discuss the new order where randomness, unpredictability, and indeterminacy were crucial elements. This sixth grade class achieved the highest mathematics scores in Riverside Unified School District in 1987-88.

In addition, to help reduce some of the difficulties students are experiencing while learning mathematics,

Gheverghese (1993) suggests that educators integrate mathematics and culture in the curriculum in order to make second language learners more confident. He believes that when students' backgrounds are included in lessons, students feel pride in who they are and tend to be more aware of other cultures. Children need to relate mathematics to their own experiences in society. Through multicultural education students are exposed to a more holistic way of learning.

Integration of Art Curriculum

The California Art Visual Framework (1989) was used to teach line, color, value, texture, and shapes, essential concepts needed to design and paint the mural. As for the integration of the curriculum, several recommendations from experienced researchers were also taken into consideration when developing lessons for this study.

For eight years, Christison and Bassano (1981) have constructed and experimented with integrated lessons for second language learners. They argue that "visual communication is universal and international; there are no limitations of pronunciation, vocabulary, or grammar" (p. 33). They have used art as a vehicle to assist students in constructing their own knowledge, finding their preferences, and becoming aware of their limitations.

Christison and Bassano (1981) discovered that the integrated art and language programs were effective for all

students. They believe that second language learners, as well as other students, benefited from art and language integrated lessons. They based their results on their students' reactions towards the lessons and skills learned through these lessons. Most of the students expressed positive attitudes towards lessons and described language and art integrated lessons as pleasing and entertaining. When asked about the skills they had learned, students reported that they had increased their vocabulary, promoted thinking, and developed oral skills.

According to Cummins (1989), Doll (1993), Freire, (1970), Nieto (1992), and Shor (1980) ethnically diverse students will be empowered when students' previous knowledge and experiences are taken into consideration when developing curriculum. Ghevenrghese (1993) uses as an example:

Art is not only a direct channel for your students' self-awareness, it provides a channel of communication by which you, the teacher, may become more aware of and sensitive to the students' needs, feelings, aspirations, desires, past experiences, and current crises. Through their pictorial representations they are often able to share with you part of themselves that they are unable to share verbally.

Many researchers discuss the advantages of interdisciplinary work, including the integration of two subjects such as mathematics and language arts, mathematics and science, or social studies and language arts. I did not find any research done on the integration of mathematics, art and culture in bilingual classrooms, which is the focus for this research.

The Study

In light of the importance of art and especially murals in Mexican culture, and the fact that no research has been done on the integration of mathematics specifically fractions and art, a study on muralists was conducted with fifth grade students at Cèsar Chàvez Elementary School. To develop cultural literacy as recommended by The California History and Social Sciences Framework (1989), the cultural roots of Mexican muralists were investigated and reviewed with the students. Among the most important muralists studied were Diego Rivera, Josè Clemente Orozco, and David Siquieros. Students learned the history of these three famous Mexican muralists by doing individual and group research. This included stories of the artists' lives, their art and their contributions to Mexican culture.

At the same time students studied how Aztec and Maya mathematical concepts influenced their art and culture. During the oral presentations, students shared that the Mayas as well as the Aztecs were "builders." "*Ellos construian toda clase de edificios,*" or "They build all kinds of buildings" said Miguel, whose father worked in construction. He seemed very surprised with his findings and wanted to share them with the class. They learned that the Mayan buildings and pyramids were carefully designed and when finished they were decorated with murals painted in bright colors. The Aztecs had some of the most elaborate

sculptures and temples. One of the few surviving Aztec sculptures is the Aztec calendar. It is a circular stone calendar which represents the Aztec universe. Most students were familiar with the calendar but did not know that it measures twelve feet in diameter and that in the middle is the face of Tonatiuh, the sun god. Neither did they know that the other carvings represent the days of the Aztec month. Students who played an instrument found it interesting that the Aztecs, contrary to their own culture, used music mostly for religious purposes. Poetry and other forms of literature were used to tell historical accounts from one generation to another.

The concepts addressed in this study were taught to the class using Freire's (1970) theory of education. Teacher and students worked together as co-investigators constructing the roots for this study. From these roots grew one of the most important strengths of this student-teacher relationship: the open dialogue. This means that students and teacher were given the opportunity to discuss issues of mutual interest and to take the time to reflect on them. From this dialogue emerged themes and ideas that were unique to this group: time and place. This uniqueness helped increase the participants' self-esteem because most of the themes addressed were relevant to their own culture and language. As a consequence students blossomed into young critical and motivated thinkers. How each of these

ideas was implemented throughout the study will be discussed in detail in the following three chapters.

Chapter Review

Educators are concerned that the curriculum in the United States is not meeting the needs of second language learners and other culturally diverse students.

Most integrated curricula combine two or more subjects. In this way students learn new concepts in a comprehensible manner. An example of this is the use of students' culture to develop language, art, and mathematics lessons. The purpose of this study is to motivate students while creating a learning environment that is enjoyable, comprehensible, and culturally relevant. The methodology used to accomplish this will be discussed in detail in the following chapter.

CHAPTER THREE

THE CONTEXT

Cèsar Chàvez is a small elementary school located in a high crime area in the east side of San Jose, California. This neighborhood consists of small homes and apartments, many of them owned or rented by multiple families. The streets are narrow and crowded with old cars. There is only one park in the neighborhood and it is usually vandalized by gangs. The public pool is often closed during hot summer days because people throw broken bottles and other dangerous objects in it. The school has a large lawn area with very few trees that is rarely used because students and teachers complain that there are too many gopher holes and it is difficult to run on it. The school's playground was recently dismantled because, according to the district, it was not safe for the children. It has not been replaced, however, because the district claims they do not have enough money to buy new safe equipment.

One of the first schools built in East San Jose by the Alum Rock Union Elementary School District in 1952, Cèsar Chàvez has a student population of seven hundred and twelve students from grades preschool through fifth grade. According to the school's latest ethnic data there are six main ethnic groups at this school. They are as follow:

Hispanic	86%
Caucasian.....	3%
Black.....	1%
Pacific Islander.....	1%
Filipino.....	2%
Asian.....	7%

Forty-eight percent of these students are considered second language learners, fifty-two percent of the students have been classified as Educationally Deprived Youth (EDY), thirty-five percent of the families qualified for Aid to Families with Dependent Children (AFDC), and eighty-three percent of the students receive free or reduced-price lunches.

At the beginning of this study, parents were asked to sign a Human Subjects document. This document, which is required by the San Jose State University Graduate Studies office, has not been translated into Spanish. Aware that most of the participants' parents spoke little or no English, I translated this document into Spanish. It was often necessary to modify the terminology to prevent cultural misunderstandings. For example, in the Human Subjects questionnaire, the researcher is referred to as the "investigator" or in Spanish *investigador*. When translated directly from English to Spanish, investigator is used to describe someone whose job is to inquire about illegal acts.

I knew that the community had already become alarmed after the passage of Proposition 187, the illegal immigration ballot measure of California. Because of this, I tried to replace this term with a similar one but failed to find one less intimidating. As expected, soon after this document was sent home, one-third of the class brought notes back from their parents refusing to sign. One parent asked, "What exactly is it that you are going to investigate?" Some parents seemed to understand, but wanted to be sure the study was not going to be used for any official purposes.

A cover letter was attached to the Human Subjects document and sent to parents. The purpose of the letter was to describe in detail the study, as well as the final project, the mural. All documents were written in Spanish to maintain clear communication with non English speaking parents. At the end of the letter a space was reserved for parents to sign, thus approving or disapproving of their children's participation in the project. To prevent further misunderstandings, very simple vocabulary was used in the letter. It was also necessary to talk to one of the parents who still had questions about the study. During the parent-teacher conference, I reviewed the letter. Aware that this parent was not understanding, I felt it was necessary to use even more simple vocabulary than used in the cover letter. I finally described the study as "my homework for San Jose

State University." After the meeting, the parent seemed satisfied with my answer and signed, approving the participation of his son in the project.

Interviews

This project included the participation of five parents, one teacher, and the principal at Cèsar Chàvez Elementary who were interviewed individually at their homes or at school, depending on the preference of the interviewee and the students in my class. The interviews followed Seidman's (1991) qualitative model for interviewing. In this model, interview questions are open-ended in order to enable participants to re-think their experiences on the topic being studied. The purpose of interviewing is viewed as an opportunity for humans to recount personal experiences and to be able to make sense from them. Seidman (1991) uses as an example a man who observes another man chopping wood. The observer sees what the woodchopper is doing but does not know why is he doing it. According to Seidman (1991) the observer will not be able to understand the woodchopper's behavior until he gives the logger the opportunity to explain his actions.

To find out about the different experiences parents and teachers have had while learning mathematics and art, seven people were selected. In order to have "maximum variation in sampling," as recommended by Seidman (1991), parents were

selected from a range of socio-economic and educational levels. The teacher, on the other hand, was selected because she is Mexican-American and I felt her experiences as a second language learner could be valuable to this study. The principal was interviewed in order to compare his perspective on education to that of the teachers and parents. The data collected through these interviews was analyzed and discussed in the following chapter.

Each parent participant was interviewed three times. The first interview focused on the participant's life history. In this interview participants were asked to share their experience learning fractions and art in elementary school. They were also asked to compare their own experiences to that of their children. By doing this, both participants and researcher were able to learn more about one another and about their school experiences. Interviews were electronically recorded, transcribed, and shared with the interviewee. Participants were given several days to read and reflect on the transcriptions before a second interview was conducted. In the second interview, more concrete information pertaining to the participant's experiences with fractions was explored. Based on my own experience as a fifth grade teacher, I concluded that many students have difficulty learning concepts such as finding the least common denominator, comparing fractions, and

working with mixed numbers. The data collected was used to explore different teaching and learning strategies. Participants were also asked questions regarding art concepts, cultural aspects of art, and the influence of mathematics in the visual arts. The purpose of this was to have participants describe specific details of their own experiences. A third interview was conducted to help participants reflect on their own experiences in order to derive meaning from them.

Journals and Assignments

Each student was given a small notebook to be kept in their desk and used as their journal for this study. Journals were used as a written form of communication and reflection. Students wrote in their journals at least three times a week citing concerns, experiences, and goals related to the project. Themes were student generated, as Shor (1987), and Freire (1969) suggest that students interests need to be considered before subject matter is brought into the classroom. Students had opportunities to share what they wrote with the class and were encouraged to participate by reading or discussing what someone else had read from their journal. Students who did not elect to share with the class, but did want to share with the teacher, were asked to leave their journals with the teacher for a private response. Students' ideas were incorporated into lessons

and concerns were addressed and discussed with the class. Through this dialoging process, students developed a more reflective, critical view of themselves as learners, a skill needed to engage in "true dialogue" (Freire, 1968 p. 80). In addition I was able to gain greater insight into their life and educational experiences.

Critical Theory and the Post-Modern Paradigm

The methodology used in this research is based on critical theory, the post-modern paradigm, described by Doll (1993), Freire (1970), and Shor (1980). In the post-modern paradigm, students and teachers are viewed as a group of individuals who explore and reveal issues together. According to Doll (1993), teacher and students need to work collaboratively to develop an open system where "learning and understanding come through dialogue and reflection" (p. 156). In this paradigm either teachers or students can initiate dialogue and all become participants (Shor, 1979). The teacher is not considered the carrier of all knowledge but a facilitator and co-learner. Knowledge is constructed by balancing the authority of the teacher and students in order to create a democratic class. In addition, to help students become critical thinkers, they are expected to actively participate and are encouraged to question the "content and the process of dialogue" (p. 86).

In addition, parents and students were asked to bring

information and paintings of their favorite Mexican artists to share in class. Shor (1979) and Freire (1973) believe that learning is an ongoing process and what matters is the process, not necessarily the product, because the product can often be incidental. As part of this process, data generated through observations, interviews and students' journals was analyzed to develop themes for data presentation and discussion.

Summary

Much research has been done on the advantages of integrating two subjects as a way of adapting curricula to meet the needs of diverse student populations. However, little research has been done on the integration of three subjects. In cooperation with parents and students, a study was conducted on the integration of culture, mathematics, and art.

The participants chosen for this study were a fifth grade class in the Alum Rock School District, five parents, one teacher, and the principal of the school. All participants, except for the students, were interviewed. The main purpose for interviewing was to provide the participants with the opportunity to recount personal experiences while learning fractions in elementary school. Their recommendations and suggestions were taken into consideration when planning the lessons.

As recommended by several researchers, students were also given the opportunity to actively participate in the project by encouraging class discussions, by promoting critical thinking activities, and by incorporating students' ideas into the lessons. The latter was accomplished through the use of the students' journals. Everyone in the class kept a journal which was used as the main form of discourse between the teacher and the students.

CHAPTER FOUR

DEVELOPMENT OF THE PROJECT

In this chapter, I discuss the difficulties and successes students encountered during this study and explain in detail, the activities given to students, as well as their reactions. In addition, I describe the process by which the final project, a mural about the students' experiences as learners, was painted and how this process increased students' knowledge of mathematics, art and culture.

Parents as Part of the Study

With the parents' and students' suggestions, the teacher guided the fifth grade students at Cèsar Chàvez Elementary School to create a mural as a final project. When asked what they believed would help students understand fractions, most parents suggested hands-on activities as well a secure learning environment for the children. Four out of the five parents interviewed remembered that they were "scared to ask questions" in class. They said that some "teachers in Mexico believed that only those who were not paying attention asked questions." As consequence, these students were physically reprimanded by having their hand slapped with a ruler or similar object. Because of this, "We did not ask questions even if we did not understand what the teacher was saying," added Mrs. Ramirez.

A safe classroom is the classroom "where students are not scared to tell the teacher that they do not understand," commented Mrs. Gutierrez.

Students agreed with their parents; they wanted activities that involved some kind of art project. "We would like to make nice things," said Jairo. Most students were very enthusiastic about the mural and all the other art activities they did during this study. These activities as well as the students' reactions will be discussed in more detail in the following chapter.

Students also added that besides making art work they wanted all their suggestions taken into consideration. I was in favor of their request and suggested we all keep a journal. Because there were so many students and little time to discuss their ideas, students used their journals to write down everything that was important to them, such as changing groups, adding colors to the mural, as well as any concern or question they had. Every day a group of students was selected to read aloud some of their main ideas, and these were written on the board for further discussion. Many times more than two students had the same concerns and therefore, these issues were given priority. The only thing that was asked from the students was to use cultural and art themes and to apply their knowledge of fractions and whole numbers when designing the mural.

The parents were asked to volunteer to help paint the mural and to donate materials for the project. Unfortunately, very few materials were donated and no parents helped paint or design the mural. This was disappointing to me at first, but after the interviews I realized that most of the parents were unavailable during class time. Homework, on the other hand, was closely monitored by many parents who were very supportive of their children's education.

Main Issues in the Study

Through this study, I examined two main issues first: the relationship between parents' knowledge in mathematics and art, and the students' ability to learn fractions and art concepts. Second, it was the purpose of this study to gain knowledge regarding the benefits of a community project where children and parents work together for the empowerment of the community; this includes promoting group and individual participation by recognizing the language in the community and the culture of its members.

Main Form of Discourse

In this project, journals and conversations with the learners were considered one of the most important forms of discourse between participants and researcher. Journals gave students not only the opportunity to write their thoughts, but also time to come back and elaborate on them

(Peregoy and Boyle, 1993). Early in the year, students' entries were generally short and not very descriptive. It was disappointing to read some of the students' journals with one or two sentences in it. As time went by, students felt more comfortable writing about concerns and feelings they had towards mathematics, art, and the study in general. Their entries were shared with the class unless they preferred to keep them confidential. Even though the main purpose of journal writing was to have an open forum for communication regarding mathematics and art, students were also asked to write about other issues that were important to them.

After the class was introduced to fractions, many students wrote that they knew little or nothing about fractions. "*Yo no se mucho de fracciones ni entiendo bien lo que son,*" or "I do not know much about fractions nor do I understand what they are," wrote one student. Fractions seemed to make students uncomfortable and frustrated. On the other hand, there were students who said they did not know a lot about fractions but they were willing to do "anything to learn." A small group of students said they had been introduced to fractions the previous year and felt comfortable studying the new concept.

Students were given homework four days each week to review concepts learned in class. Homework included

critical thinking activities, research assignments, and an interview.

Critical thinking problems, according to Shor (1987), are those that help students become independent learners by developing "critical consciousness" (p. 189). This means that students will not only learn mathematical concepts, but they will be able to understand the reasoning behind each problem. He argues that to do this teachers need to concentrate on content and methods. Content can be developed by using the students' real life experiences. As to methodology, Shor (1987) recommends that students and teacher work as co-researchers on themes proposed by the students.

As the study progressed, students became more comfortable working with fractions. Some students wrote extensive entries describing what they had learned. Julia wrote the following entry:

Fractions are numbers that show something cut in parts. If you have a pizza and you divide it in eight parts the denominator will be eight. If I eat one the numerator will be one. This means I ate one-eighth of a pizza.

They gave clear examples of problems and drew pictures to make their entries comprehensible to the reader. Every time they had a concern or question, students were given the opportunity to reflect and to write in their journals. As their knowledge of fractions and art increased, their

attitude became more positive. One thing that helped students was to see some of Wassily Kandinsky's paintings. This Russian painter abandoned realistic painting to develop a nonobjective style. Most students looked at his paintings with surprise "What is that?" they asked. I explained to them at this point that art does not have to be realistic and that painters sometimes use figures to represent other things beside objects, such as feelings. They were also exposed to Pablo Picasso's Three Dancers painting. In this work, Picasso uses collage cubism techniques but instead of cutting and pasting, he creates illusion with the brush. Students noticed that there were pieces of objects and parts of people in the painting. They also saw sections of rectangles, triangles, circles and lines. They noticed that the surface was divided in sections and each section had a different color. After this, we discussed what art was and students agreed that art "was anything a person decided to paint."

For the first time students felt free to draw anything they wanted to. They were not asked to be realistic or abstract. This promoted a desire to explore and experiment among the students. It was rewarding to see so many students eager to learn more about art techniques and art in general. I heard students ask questions such as, "Can I borrow this book to read at home?" and "Do you have another

book for me?"

Students were free to divide the surface of the paper in as many sections as they wanted to. The only thing they were asked to do was to think and to decide what they wanted to paint. One boy wrote "*Me siento bien en la clase de matemáticas porque estoy aprendiendo mucho de arte y matemáticas.*" Translated into English this means, "I feel happy in my mathematics class because I feel I am learning a lot about art and mathematics."

Most students wrote that they had difficulties interacting with their parents because some of their parents had never studied fractions. Most parents had a fourth grade education or less, with one parent holding a bachelor degree and enrolled in a master's program. One participant shared that she was not able to help her son because she had never been to school stating, "*Yo no se nada,*" which means "I do not know anything." With tears in her eyes she said she regretted the fact that she had never attended school. She was only now learning to write and read. She also asked if the school was going to have parent education courses because she would like to learn more about mathematics and other subjects to be able to work with her children at home.

Proposition 187 and How it Affected The Participants

Following the 1994 California election in November, students were having a difficult time concentrating on

school work. After these elections the only thing students felt motivated to discuss or write about was a California initiative, Proposition 187. According to the League of Women Voters of California Education Fund (1994), Proposition 187 would deny non-emergency health care and public education to those people who do not have legal status in the state. Educators, law enforcement officers, health care facilities personnel, and social workers would be required to report anyone they suspected to be illegal.

Students felt that something was wrong, but did not seem to understand exactly what it was. They heard their parents and older siblings talk about this measure but knew little about what it meant. Talking with the children I realized that they were worried thinking that this law had been passed by "whites who were against Mexicans." Students were eager to know more about taxes, illegal immigration, and how Proposition 187 might affect their lives. They asked questions such as "That means that all Mexicans will have to go back to Mexico?" This issue provided the opportunity to pose a problem and to create generative themes as recommended by Freire (1970) and Shor (1987).

Students knew little about United States history and government because usually this historic period is not introduced until students have finished studying the Revolutionary War. At the time we were studying a unit on

Native Americans but I gladly interrupted it to discuss the United States as a country. It was clear that students were concerned about Proposition 187 and how it was going to affect their lives. As expected, students had many questions. They asked things like, "How did the thirteen colonies become the United States? Why were people unhappy with the King of England? Why was it better to have a President than a King? Is the President the most powerful person in the government? Who decides how much taxes we have to pay?" These and many other questions were addressed during and after this study as part of the social studies fifth grade curriculum. It was evident that the more students learned about the United States government, the more willing they were to continue studying other subjects because their questions had been answered. This generative theme here helped because students felt closely related to the issues discussed in class and therefore were more motivated to learn.

Preliminary Mathematic Activities

Before introducing the concept of fractions, students experimented with different ways of dividing a surface into equal parts. To explore this concept, students worked on an integrated mathematics and art project. According to Daniel (1990), integrating subjects helps minority students relate better with the material. In this assignment students were

asked to divide a sheet of graph paper by drawing six equal squares separated by equal distances. Most of the activity was done in class but students were asked to finish it at home. The purpose of this activity was not only to allow students to experiment with shapes and space, but to promote higher order thinking levels. When students brought back this work it was clear that they had great difficulty deciding the size of squares as well as the distance between them. Students said they felt uncomfortable experimenting with shapes and measurements because they were "not used to doing it." Only three students drew six equal squares separated by equal distances. Sharing their work with the class they confessed they had not measured the distance nor the squares. They believed their work had been successfully done by "chance." Instead of measuring, these students folded the paper in equal parts and after the folds were done they drew the lines. After hearing this, the other students asked for another opportunity to repeat the assignment. When the students brought their papers back, a majority of them were happy to show that they had successfully measured the squares as well as the distances between them.

Another way the students experimented with the concept of fractions was by making kaleidoscopes. Following Piaget's (1990) recommendation, activities like this help

students make a link between their previous knowledge or schemata and new concepts being introduced. Students were asked to make a kaleidoscope using two different sizes of squares. They were given a white twelve-inch square and ten colored three-inch paper squares and asked to fold the large square into four equal sections. Students folded the large square in two different ways. Some divided it into four small squares and others made four triangles. It was apparent that most students were able to recognize geometrical shapes such as the square and the triangle. When the class compared results, a majority of students decided they liked the four triangles better and changed their folds into diagonal ones to make triangles. After this, students were asked to fold their small squares into equal parts. Some squares were folded many times and some were folded only one or two times. As in the previous activity, some students felt nervous experimenting and creating something without gaining previous approval. They kept asking, "Its this O.K.?" They needed constant reassurance that what they were doing was correct. Monica, a responsible student, told me with a desperate voice, "You have to tell us how to do this." Realizing that a large number of students were not yet independent enough to design their own kaleidoscopes, I helped the students by showing them a piece of paper divided in four sections and asked

what one of those sections represented. Students quickly said it was one fourth of the paper and most seemed to understand that a unit could be divided into equal parts and thus become a fraction. The more students learned, the more comfortable they felt with their work and eventually they made interesting patterns by gluing the small folded squares to each triangle. At the conclusion of the lesson they were asked to tell how they created their patterns and to explain the folds by using fractions. If they had folded a paper into four parts and were showing two of those four parts, they had two over four or one half.

Preliminary Art Activities

To help students become more comfortable with designing and painting, another art assignment was initiated using water colors. Students were asked to draw free lines on a twelve by eighteen-inch sheet of white paper. The only requirement they had was to draw scribbles using continuous lines that went from one edge of the paper to the other. They were then asked to show their drawing to a partner and together find shapes made by these lines. Some students found animals, shoes, faces or flowers. Another group of students decided to make abstract designs. Students showed no difficulty in experimenting and creating figures in this activity.

Surprisingly, applying paint to the designs was

difficult for some students. It was evident that many had never used a paint brush. Because painting was an important part of this project, it was necessary to spend time teaching students everything from the proper way to use a paint brush and working with different sizes of brushes to painting techniques.

Only primary colors were distributed and students were asked to make their own colors. They had no difficulty mixing colors since this had been practiced in previous lessons. Students seemed very pleased with the results of this assignment and decided to use these techniques to paint the mural. They did not want completely realistic pictures, yet they did not want to draw something completely abstract.

Students were given an assignment using chalk to introduce texture working over dark construction paper with different colored chalk. Students felt confident creating a variety of designs. Some students divided the paper into sections like they had done in previous activities using different colors of chalk. Others did more detailed work drawing realistic objects. They experimented with a variety of colors, shapes and textures. Students who created more realistic work smoothed the chalk over the paper creating light shades of color while others created more abstract designs by saturating the paper with chalk, making their work look very bright. Completing this activity I felt

satisfied to realize that the class was finally prepared to start the planning and designing of the mural.

Students As Part of The Community

Enright and McCloskey (1988) recommend that students be exposed to field trips and other outside school activities to help them learn more about their community. Following these two researchers' recommendations, I took the students on a field trip around the neighborhood where they were able to see different murals. Students noticed that most of these murals were "nice paintings" about the history of the Aztecs as well as modern Mexico. The last mural we saw had graffiti all over it and this became a concern to the students. They felt distressed to think that someone could "tag" the mural we were about to paint and "lose all our work."

Intensive discussions were held in class about where and how the mural was going to be painted. This gave students the opportunity to become participants as well as to construct their own knowledge (Doll, 1993; Freire, 1970). After a few days of deliberations and two walks around the school, most of the students decided that the best place to paint the mural was on the front wall of the library. However, some students were concerned that their mural would be "tagged" or covered with graffiti. One student suggested that they paint a wall inside the building. I understood

their concern since the school is constantly vandalized by gang activities. Often, before school starts, workers need to replace broken windows and paint over graffiti on walls. Three years ago a student in my class was shot while playing at the park after school. This boy was playing with a friend and did not notice that two rival gangs had arrived. Apparently, they were arguing and one young man took out a gun and fired at another. He missed and hit my student instead. Following Shor (1987) and Freire's (1970) recommendation to use themes with which students have an emotional connection, many discussions about gangs or "pandillas" were held in class. Some students argued that they wanted to create the mural on the outside wall, but were afraid to have the mural "tagged." Following Freire's (1970) recommendations, I posed a problem to the class. Students were asked to write a list of words that described their responsibilities as community members. In addition, they were to work in groups and discuss ideas on how to combat gang activities. The general consensus was that they all wanted to have nice neighborhoods and that they were trying to keep it this way. They felt, however, that it was not only up to them. "Everyone will have to help" proposed Orlando. "I do not know what to do," wrote another student, "*Yo solo soy un niño*," "I am just a boy." After several days of discussion something happened that made the students

even more confused than before. A girl came running to class with tears in her eyes. She said that someone had "tagged" the wall we had chosen for the mural. This made our discussions even more intense than the day before. At this point most students had changed their minds about painting the mural outside. The following day Mario, a bright talkative boy, brought some interesting news to the class. "Don't worry teacher," he said. "I already talked to my cousins who are gang members and I asked them to please not to tag our wall because I am going to be painting a mural there." The rest of the class took this news very seriously and decided to take the risk and paint the mural outside on the wall that was chosen. This student became my informant. According to Glesne and Peshkin (1992) the "informant" is the person or persons that help the researcher by making suggestions, developing theories and making introductions (p. 51).

Students were asked to draw a picture integrating mathematics and art. Monica, a small quiet child, suggested the class make faces using geometrical figures, an activity they had done the previous year. Elena, on the other hand, who had studied the basic concepts of fractions in fourth grade, said, "We can make one pizza per group and divide it into several pieces." Realizing their difficulty in deciding what to draw, I suggested working together and

drawing a large picture incorporating everyone's ideas. Mario's response to my proposal was, "We don't have a paper big enough for all of us." At this time, I posed a question asking the students if the only surface they could use to draw on was a piece of paper. Students replied with a variety of responses. Among these were drawing on sand, painting on the pavement, and drawing on material. No one mentioned painting a mural because, according to Jorge, a talkative boy, parents and teacher "would never allow children to do that." I agreed with Jorge and explained to the class that in most cases painting a wall was not acceptable, but that this time was different because we were going to design and paint a mural. It was evident that most students knew what a mural was because after I said this they jumped out of their seats smiling and making all kinds of comments such as "yes" or "I know what I want to do." Others shared that they could not wait to get home to tell their parents what they were "going to do in class."

After the principal approved the painting of the mural and following Shor's (1987) recommendations, together the students and I selected the wall that was best situated for the mural. They measured the wall using the metric system. Later, they drew the dimensions of the wall to scale on paper. In class, they worked in groups of two or three to divide the wall into equal sections.

Later students worked with different kinds of media to draw a picture to use for the mural. The first picture was done in water color. The main focus of this assignment was to discuss design and color. The next painting was done in chalk in order to discuss line, shapes and texture. After these two lessons, students were able to experiment by painting a picture using mixed media. At the end, the students' art work was displayed in class and everyone had the opportunity to talk about his or her painting and to say why would it be important to use his or her painting as the model for the mural. This selection process took a few days because some students saw this assignment as another opportunity to compete. Noticing the students competitive spirit, I reviewed the importance of collaborative work and told them we could not start the project until everyone came to an agreement. Finally, students selected a painting but asked that a few changes be made.

To incorporate students' culture into the lessons, students were asked to do research using library reference materials and to write a paper about one of the best known Mexican muralists such as Diego Rivera, Josè Clemente Orozco, or David Siquieros.

Many art books were brought to the class in order to study the art of murals. These books also served as references for those students who were unable to visit the

public library. According to three single parents they were not able to take their children to the library because they worked nights and weekends. Other students, whose English was very limited, used the books in Spanish arguing that there was a limited selection of these books at the public libraries. After completing their reports, students brought them to class to share and gave oral presentations discussing the artists' lives and main art contributions to Mexican culture.

The second research assignment was done in groups of two or three students. They chose a Native American tribe, such as the Mayan or Aztec, and studied what that tribe's mathematical understanding and skills were; they also studied what role art played in their lives. Later, students shared this information orally in class.

Students also interviewed their parents or guardians. The main question asked was how did their parents or guardians use fractions in their daily lives. These responses were brought back to class and discussed in small groups. Students then reviewed the information collected through their research about the different ways people use mathematics in their daily lives.

In class, new concepts were introduced including equal fractions, mixed numbers, fractions in measurements, and multiplication of fractions. With each lesson students were

encouraged to give suggestions for further reinforcement. The purpose for this was to help participants maintain an open dialogue so that negotiations and reflection could take place.

A large majority of students became very involved in discussions when an issue was to be negotiated. Many of them discussed every detail with great interest. One day, when students were asked what they thought would be a good review activity for fractions, Maria proposed to have the class play bingo using fractions instead of whole numbers. Most students liked her idea but others did not agree. They believed whole numbers as well as fractions needed to be included to make the game "more interesting." After a few minutes of deliberations the class not only agreed to play bingo but insisted we use fractions as well as whole numbers in the game. They also decided to make their own boards drawing sixteen squares on heavy weight paper that I later laminated. Using a dry-erase marker, students wrote the numbers on their boards. Whole numbers were played as they usually are in bingo games. If the caller pulled out a four, students who had a four on their board covered it up. Fractions, on the other hand, were dealt differently. If the caller pulled out one-half all fractions equal to one half such as two-fourths, three-sixths, four-eighths, etc., were covered. This game was played on many occasions and

every time the class played students commented how much they enjoyed playing bingo.

Once the location for the mural was chosen, students were asked to divide the wall into equal sections. Quickly the class agreed that they had to measure the surface before assigning sections to groups. Using the metric system, students measured the width and length of the wall. When the results were brought back to class, students could not agree on the exact measurements of the wall. Each group had slightly different results. Students then reviewed how to use the metric system. They measured the wall again. This time most of their measurements coincided. When asked, no one knew how they were going to transfer the measurements of the wall to paper. This provided another opportunity for problem solving. Students gave different answers to this problem, but Elsa said, "Why don't we make them up?" I explained that we could not "make them up" but that we could transfer measurements to scale. It was difficult at first for students to comprehend this concept. To explain this concept to the class, students were asked to work in groups of two and to draw each other. They measured their friend first, then using a scale of one centimeter for every ten centimeters they drew each other on paper. If their partner's height was ninety centimeters they transferred this measurement so that their drawing's height was nine

centimeters. After a few exercises, they were able to understand that when drawing a large object on paper it is necessary to change the measurements.

Students were very excited about painting the mural. Some were very happy and kept asking "*Cuando vamos a poder pintar la pared?*" or, "When are we going to be able to paint the wall?" According to some, they had never been allowed to draw or paint on any wall. Sandra was nervous when writing in her journal, "I am very scared because I think I'm going to mess it up and won't be able to fix it." At the same time she added, painting the mural was going to make her feel happy. "I feel good because I will be able to show it to my children and their children and tell them I did it in elementary school."

Students' Culture in the Curriculum

To include students' culture into the curriculum, students were asked to research one of the following Mexican muralists: Diego Rivera, Josè Clemente Orozco, or David Siquieros. Peregoy and Boyle (1993) believe this is important because it helps students learn new concepts while it makes them feel proud of their cultural background. Parents were also included by sending them a letter with details regarding this research and by asking them to volunteer to assist with the project or donate materials. McCaleb (1994) suggests that parents need to be viewed as

valuable resources and therefore their advice should be considered important.

The students conducted research and developed reports. They enjoyed the paintings and commented that "It must have been a lot of work to paint those big walls." Maria commented that Orozco had painted the first Mexican mural, The Prometheus, in the United States. Mario, who did his report on Sequieros, mentioned that "Rivera and Sequieros were friends." Students seemed particularly interested in the painters' lives. Jorge came to class very excited because he had discovered that Diego Rivera, one of the Mexican muralists assigned for this investigation, had a twin brother who had died at an early age. Someone else was interested in Diego Rivera's wife, Frida Khalo. Frida had many illnesses growing up and as a result one of her legs was longer than the other. We discussed how physical disabilities had not stopped many people such as Roosevelt, Einstein, and Frida Khalo from becoming famous. Through this activity students came to understand that famous people were real people like themselves. This provoked a discussion in class about the kind of goals students had for their own futures. As suggested by Doll (1993) and Freire (1970) to have a rich curriculum it is important to be flexible and allow students to generate themes that are important to them. Following these two researchers'

recommendations, the class was encouraged to talk about their concerns and goals for the future. All students agreed that education was important, but only a few students speculated about what they wanted to be when they grew up. Some students said they wanted to be policemen, artists, architects, firemen, and teachers. One wanted to be a doctor, and four said they wanted to be famous soccer players.

Students Constructing Their Own Knowledge

Finding the right place to paint the mural was relatively easy compared to arguments about selecting the subject for the mural. The only requirement was that students were to create a painting using concepts learned through fractions and art. Each student made a sample painting by working with a group in class as well as with their parents at home. The finished paintings were displayed in the classroom for everyone to see. Among these subjects were eagles, pyramids, the Mexican flags, schools and other themes related to Mexican culture. As suggested by Doll (1993) students organized and combined information they had gathered through their investigations. As part of the selection process students were to show their paintings to the class. Based on their findings they explained why their work should be used as the main theme for the mural. Cecilia argued that "It was important to have the Mexican

flag," because most of the students were Mexican. Carlos, on the other hand, wanted the pyramids because he felt that "If it was not for the Aztecs, Mexico would not exist." Following many hours of deliberation, students agreed on Maria's drawing. Maria's group did a chalk drawing dividing a paper into six equal sections. They assigned a theme to each of the sections. Each section would represent one of the main activities at school. The four sections in the middle of the mural were assigned to four academic subjects, ESL or English as a second language, mathematics, science, and language arts. One outer section was assigned for extra curricular activities such as games, sports, or field trips. The other outer section was to represent the history of the school and neighborhood. The students were reminded that this mural was to be painted using the mathematical and art concepts learned in class. For the science section they drew a bicycle from the unit on simple and compound machines. Maria explained that the tires could be divided into four parts. This would represent a unit divided in four equal parts. The group also decided that the lines needed to be drawn freely. From the lines students were to find shapes like they did in their watercolor assignment.

Painting the Mural

Christison and Bassano (1981) agree that art can be used as a vehicle to help students learn different concepts

as well as to learn art. This was evident when students started to paint the mural. First, they were asked to draw sketches of their drawings on paper. After they finished, students went out to the selected wall and happily began drawing. They soon started complaining that they did not have enough space. Some students stated that other people "were getting in their way." The class was asked to come back and decide how to solve this problem. Students decided that it was important for each student in the group to have a specific duty. They felt it was necessary to have a coordinator, an assistant, a brush manager and a captain. The coordinator was to "talk with the teacher for planning," the brush manager was to coordinate and maintain materials. The captain was to make sure everyone did his or her job. At the same time they agreed that they could not all paint at the same time. Because of this, they developed a schedule so that everyone would have an opportunity to paint.

The painting of the mural lasted approximately five months. Day after day students worked happily on the mural; the cold winter days in January and February did not stop them from wanting to paint. As they finished each drawing, students applied color using house paint. The only colors they were given were primary colors and white. Students were asked to make their own colors by using their knowledge on color mixing. Students created mainly dark greens, brown

and orange. The class agreed that they did not want too many different colors in the mural because as Maria mentioned, "It would be too confusing." "If someone makes a green and uses it all, and you need more, how would you remember how much blue and how much yellow you put in it?" I suggested measuring the amounts of paint and after that labeling each can. Students agreed this was a good idea but very few made the attempt to do it. As a result, students discovered that they had three different greens, three different blues and two different oranges.

The first section finished was the ESL painting. It had geometrical shapes of different colors and hidden within these figures were the letters E S L. The mathematics painting, finished next, included fractions and Roman, Inca, Aztec, Maya, and Arabic numbers. The science drawings were more elaborate than the other drawings and therefore, students spent more time on it. This group of students, in particular, was very concerned about details and therefore erased their drawings a couple of times until they felt satisfied with their work. They drew a microscope, a bicycle, an umbrella and other items which they had used during science units studied during the year. In the section assigned for school activities, students painted soccer courts, balls, a clown shoe, Christmas trees, a train, and many presents. On the section chosen for the

history of the school, students drew nature scenes including a lake, trees, dinosaurs, birds, bushes, and other plants. Language arts was the last section to be completed because students argued they "could not think of anything that would illustrate this subject." At the end they painted letters on an open book, pencils, colors, crayons, and a lamp.

The paintings were completed by April. Students met in front of the mural to discuss the final results of their work. Most students were pleased with their paintings. They had used the concepts learned in mathematics and art and they had learned "many other things while painting this mural" as Elena commented. Students agreed that they "had learned more about their culture and background." In addition, they had the opportunity to study other cultures such as the Mayas, Incas and Aztecs. Miguel believed that one of the most important things she learned was "to work together with others." At first students encountered many difficulties. They complained that there were either too many leaders or too many students who needed constant supervision in each group. This made it difficult for students to organize in groups. This changed after students were assigned to complete specific jobs. Students became more confident and independent learners. They stopped asking constantly what to do. Elena needed green for her painting but forgot what colors to mix. Instead of asking

me, she went to her notes and looked at her color chart.

Students also became very responsible and completed their tasks well and on time. They learned to stop painting fifteen minutes before the bell to give them enough time to clean up and put all the materials away. No one argued that they did not want to clean up or left materials dirty because other members of the group would remind them of their responsibilities.

Parents as Part of the Curriculum

Students were reminded to ask their parents if they would volunteer to help in the classroom or to help paint the mural. Parents, however, always said they were "too busy to do it." Parents who did not work usually had one or two young children to care for. Parents argued that if they were to bring the "little ones" with them they would not be able to help very much. Some students in the classroom were being raised by grandmothers who were busy with other grandchildren. More than seven students were living with single parents who worked all day and sometimes all night. One family had lost their business and had moved the family into the garage because they could not afford mortgage payments. Mrs. Garcia lost her two-month-old baby during the winter break. The baby became ill and was taken to different hospitals. Doctors were unable to find what was wrong; then she was sent back home where the baby died.

The Mathematics Through Art Mural

Figure II

This was one of the most difficult moments Sandra, one of the students, had to encounter during the semester. As recommended by Peregoy and Boyle (1993), shared beliefs, values, and behavioral patterns among these participants were taken into consideration throughout the study. Sandra, who was devastated by the loss of her only sister, asked me not to tell anyone what had happened. Faced with such a traumatic issue as death, Hispanics tend to share their feelings only with relatives and close friends. Aware of what I was expected to do within this culture, I did not share this with anyone in the class. It was difficult, however, for me to remind my students about the importance of education that day. I felt that, though death is part of everyone's life, neither school nor the curriculum provides opportunities for students to reflect on this issue.

Mathematics In the Post-Modern Curriculum

"Why do we need to learn fractions?" asked Mario. This question was discussed in class and students wrote a list of reasons why fractions might be important. Students then interviewed their parents to ask if they used fractions at work or at home. Through this assignment students had an opportunity, not only to explore how mathematics is used in real life issues, but to learn more about their parents' occupations. Some students said that their parents use mathematics at work in construction, carpeting, selling

jewelry, and counting tortillas. At home, parents said they use mathematics to go grocery shopping, to pay bills, to balance their check books, to bake, and to do budgets.

Students were asked how mathematics has been used among different groups. They were asked to do research on the Maya, Aztec or Inca. They were to focus their research on these civilizations' mathematics in art concepts and their importance within their society. Cocking and Chipman (1988) argue that mathematics are not viewed in the same way by all cultures. Many cultures have developed their own symbols and mathematical concepts (Gheverghese, 1993). Students learned that these groups had different mathematical systems. As Roberto said, the "Aztecs counted numbers using dots organized like a flag, the Mayas used dots and lines, and the Incas a rope with knots." Students also compared their findings regarding the importance of mathematics and art. They learned that these groups studied mathematics and practiced it when counting, trading, and when studying the stars. Art was also very important to them. They used art to illustrate religious and social events such as sacrifices and festivities.

Ricardo asked if he could also share his findings about the Maya's social events. He became very interested in this group when he read that the Mayas played a game similar to soccer. He was also interested in soccer. The Mayas had

two teams, one on each side of the court. The purpose of the game was to kick the ball and try to pass it through the opposite team's court. Most of the boys were fascinated with this discovery because their favorite game was also soccer. One boy added, "I did not know that people have played soccer for hundreds of years."

To encourage students to be proud of themselves, as recommended by Gheverghense (1993), they had an opportunity to talk about their ancestors. The students, however, knew little about their roots. They did find that they all had something in common. They were Mexican or Mexican-American. They decided to expand their research about the Aztecs learning their education, politics, and economy because it related to their shared cultural history.

Assessment

Students were assessed through informal observation and by tests designed for this particular student population (Pèrez and Guzman, 1992; Cummins, 1989). Informal observations were done in class and outside when painting the mural. These observations were conducted to determine the needs of the students. Students also evaluated themselves in writing and orally. Oral evaluations were done in class where students had an opportunity to reflect on their own work and their group work. Students were also asked to write a one page report describing their role in

the group as well as specific worked they did while painting the mural. After this, they wrote a paragraph evaluating themselves including things they felt were successful and those they felt could have been done better.

Chapter Summary

The main issue that conflicted with this study was California's Proposition 187, the illegal immigration ballot measure of California. Because of the immediacy of the issue some parents felt skeptical about signing any kind of document. After all their questions were answered, however, parents signed all papers necessary for their children to participate in this study.

Initially much of the communication between participants and researcher was done through journal entries. This helped those students who had a difficult time discussing their ideas in front of the class. Nidia, a shy little girl, wrote, "I do not like to speak in front of the class." Many times she asked me if I could read her paper to the class, and I did. She wrote long and very detailed entries but felt insecure about oral presentations. At that time, I felt that it was more important to give students a sense of security than to teach them how to speak in public. For other students, journal writing was also useful because it provided them with the opportunity to organize their thoughts and to record their questions.

Students slowly became more confident about themselves and their work; this made them more willing to speak to their peers or in front of the class.

Preliminary activities done with the students helped them develop higher levels of thinking skills. These assignments consisted of integrated mathematics and art activities. Initially, students felt uncomfortable because they were asked to explore and experiment. As they progressed students became more willing to take risks. They did drawings that were completely abstract, or they divided a shape into fractions using a different color for each section. These activities were considered risky because as Nidia said, "No other teacher had ever taught them how to paint like this," and they were afraid to make mistakes. Most students agreed with Nidia claiming that they had had little exposure to abstract art. They added that most drawings they had done in previous years had been mainly realistic.

Painting the mural and studying three of the most famous Mexican muralists increased students' awareness of their own culture. They felt proud to learn that these three muralists are well known not only in Mexico but around the world. It also provided an opportunity to discuss social issues such as gangs, vandalism and graffiti.

Reflections

As a teacher, I began this research hoping to find a way to teach fractions and art to culturally diverse students. I did this by forming a new relationship with my students. We all worked together as co-investigators using dialogue and the data from the journals as our main form of communication. This helped us generate ideas and make decisions on issues of mutual interest. Before this, I had struggled for three years trying to teach students the value of fractions in real life situations, but I was not successful. Students were not interested because they could not see the value of this concept nor its relationship to their lives. Based on this experience, I developed this study and found it to be effective for many reasons. Students learned that their questions were always answered or taken into consideration for further discussions. I became aware of the importance of doing this when Proposition 187 passed. Students were afraid for themselves or for other members of their family. That day students walked into to class asking me, "Teacher, do you know what 187 is going to do to the Mexicans?" Unaware of the extent this issue was affecting their lives, I told them that we could discussed this later but they did not want to. Elena said, "We might not be here later, teacher." Realizing the need students had to share their feelings, I did the best I

could and saved my lesson plans for another day. From one day to another, school was not important to them anymore. The most important thing for them was their families and their future in this country. Because of this, we dealt with this issue first, answering all the questions students had. I became aware that students were ready to move forward when they starting asking me, "What are we doing tomorrow?" and "Are we going to do art?".

Because of our relationship, students became more assertive. On several occassions we had serious discussions about social and political issues where they strongly disagreed with me. On one occasion I mentioned that, as a foreigner, it was difficult for me to understand why there were gang confrontations between those from the south and those from the north. My understanding was that the majority of the members of both groups were Mexican or Mexican descendents. This led to a very heated discussion and students shared their various points of view many of them disagreeing with me. They argued that "Gang members are not only Mexicans but come from different Latin American countries and some Asian countries as well." They also explained to me how historically these two groups had become rivals. It was fascinating to see these young students become critical and independent thinkers, who were capable of defending their point of view, even if their opinion was

different from that of their teacher.

At the end, I realized that what students learned about fractions and art was very important, but at the same time it was important to see how they had changed as people. They became independent and self-confident. This made me think that many times we look at what we are teaching without thinking how we are teaching it, and how we teach is what makes a difference. This idea as well as the participants' reactions to this study will be discussed further in Chapter Five.

CHAPTER FIVE

PARTICIPANTS' AND RESEARCHER'S REACTION

In this chapter parents', students', and researcher's reactions towards this study are described. The main issues addressed are parent participation, development of the project, and assessment.

Many parents prefer to be contacted personally rather than by mail. Letters and notes were often disregarded by parents. On the other hand, each time a parent was contacted on the telephone, or met with personally, their attitude was positive and helpful. When they were asked why they had not signed a document or letter, many parents stated that they had not received it. Some believed their children had either lost the papers or left them at school. Some children agreed with their parents but others complained that their parents had not looked at the papers. Regardless of the real reason, it would have been impossible to complete all work required for this study without contacting many parents personally.

I particularly noticed how much parents enjoyed personal interaction during the interviews. On many occasions, the interviewees spent a long time talking about their private lives. One parent started crying and told me her husband had a drinking problem. During the rest of the interview she kept addressing her problem and disregarding

the questions. Because of this it was necessary to stop the session and continue with the questions during a second interview. It was clear that parents felt comfortable speaking in Spanish and having someone who could understand them and was willing to listen.

Although parents were helpful during the interviews, they did not seem enthusiastic about helping in class. As recommended by McCaleb (1994) parents were asked to participate in many ways. However, during the interviews, most parents admitted that they had never studied fractions, and that they did not have the skills to help in a fifth grade classroom. When they were asked for suggestions, many said they would be able to participate more if I would teach them fifth grade mathematics. They insisted this would be the only way they would feel confident enough to work with their children at home and at school. Because of this, I recommend that schools such as Cèsar Chàvez, which has a high influx of second language learners, develop a program to teach mathematics and language arts to the students' family members.

Through journal writing students indicated they were eager to learn but were afraid to take risks. They did not want to say anything that would put them in a position where others might "make fun of them." Discussions about the journals were not of high interest to all students. To help

students change this attitude I also kept a journal. We all read our entries to the class and asked for comments. This helped students view the teacher as part of the class. Changing the relationship between teacher and students as suggested by Freire (1970) made the students feel more secure and willing to be active participants. This not only brought the class closer, but helped students to take greater risks. Following the journal activity, the class became more engaged in meaningful conversations that interested everyone.

Among the things exposed through the journaling experience was that a large majority of the students feared mathematics. They believed that fractions were difficult and parents were often unable to help them. When the students interviewed their parents and discovered that most of them had never studied fractions, some students began to question the importance of learning this concept.

The day California Proposition number 187, (illegal immigration ballot measure), was approved the class refused to do anything but discuss the issue. It was necessary to set aside lessons planned for the day and concentrate on questions and concerns students had regarding this measure. As recommended by Shor (1987), we took time to ask and discuss questions. This flexibility within the curriculum is Doll's (1993) idea of Richness in the curriculum.

Allowing the curriculum to be flexible enough for many interpretations provided the students with the chance to learn more about social and political issues that were in one way or another affecting their lives. The more students learned about the United States laws the better they felt. I heard comments such as, "Now I understand" or "It is not as bad as I thought." Having all their questions answered, students were then more relaxed and willing to continue with everyday activities. Based on this experience, I learned how important it is for students to discuss issues relevant to their lives.

Daniel (1990) suggests that integrating subjects helps student learning in many ways. By integrating fractions and art, students who saw little need for the study of fractions developed interest as they understood that fractions were not only addressed in mathematics, but also used in real life issues such as the development of the mural.

Recursion, one of Doll's four Rs, also provided students with multiple learning experiences. Students were given the opportunity to reflect on issues regarding their individual or group work. Their reflections were then brought into the class and integrated into the lessons. Choosing a theme for the mural was very difficult for some students. Allowing the time for them to reflect on their ideas, however, gave them the chance to see other students'

interests and points of view. "A flag is O.K. but I guess everyone has one," said one student who insisted we painted the Mexican flag as the main theme for the mural. She understood that her idea was good but was not as creative as some other students' ideas. In addition, these lessons helped students make connections between them and the concepts learned in class achieving Doll's (1993) idea of Relations.

Rigor, the last but most important of Doll's (1993) R's, was acquired by following closely all recommendations made by The California Mathematics Framework (1989), The California Art Visual Framework(1989), and The California History and Social Sciences Framework (1989).

Students increased their understanding of one other's cultures by studying the Aztecs, the Mayas and the Incas. They learned about social and political aspects of each of these cultures. This research also provided opportunities to learn about the importance of mathematics and art in these civilizations.

Students who focused their investigation on the Aztecs were those who were more interested in their own heritage. A few took this investigation even further and asked relatives if they knew of any Native American influence within their families.

One assignment that encouraged pride among the students

of their Mexican heritage was the study of Mexican muralists, Diego Rivera, José Clemente Orozco, and David Siquieros and Khalo. Through their investigations and discussions students learned about the importance of murals within Mexican culture. It became clear to them that most of the themes used in these murals had a correlation with Mexican history.

Most students became particularly interested in Diego Rivera's private life. One student shared that Rivera had a twin brother that had died. Real issues as recommended by Shor (1987), such as losing someone you love, captured the other students' attention. As a result students were able to view Rivera as a real person with real life problems. This increased their appreciation for Rivera's contribution to the arts and to Mexico.

During the preliminary activities students and teacher worked together to explore relevant issues (Doll, 1993; Shor, 1980). At first students said they were "not used to doing this." Students stated that they felt more comfortable when they were told what to do and how to do it. "*Las maestras siempre nos dicen que hacer*" (Teachers always tell us what to do), Maria responded. When asked to draw six equal squares separated by six equal distances, students felt uncomfortable. Students wanted to be given exact measurements. In the end the students completed the

assignment, but only a few were actually pleased with the results.

The attitude of the students began to change when they made kaleidoscopes. They liked the fact that we used colored paper. Using colored paper gave students the feeling that this was more an art project than a mathematics assignment. There was open communication between students and teacher. On some occasions students were asked to reflect on issues discussed in class, after school, and at home as recommended Shor (1987). Students asked questions about designing their kaleidoscopes using twelve inch colored paper squares. Students took materials home and shared this activity with their parents. When students came back to class the next day, most of them had started designing their kaleidoscopes. "I like my design because I folded the red squares in two parts, the green ones in three parts and the blue ones in four parts," said Elena. Addressing these issues in class made students feel comfortable with their findings. Through this open dialogue, as suggested by Freire (1969), students slowly became more willing to experiment and to be more creative.

During the second preliminary mathematics and art assignment activity I realized that some students did not know how to use a paint brush. I had expected that everyone would have some basic knowledge on how to use a brush by the

fifth year in elementary school. It was necessary, however, to teach students everything about using water colors from painting techniques to how to care for materials.

The third preliminary mathematics and art activity made it obvious that students had learned to be independent learners. At the beginning, they wanted to draw only realistic pictures. They also had a difficult time combining fractions into their art work. As the time went by, students were more willing to take risks and to draw more abstract representations. They also decided to include other mathematical concepts into their art work besides fractions. They were more secure in themselves and willing to experiment with different designs. Ricardo, who became interested in Kandinsky's work, did an abstract painting. When discussing Ricardo's work, students said they could not see anything in it but "by using so many colors, it gives you a feeling of happiness." Some student continued to draw realistic paintings. Many others painted very unique pieces and, because they had increased their knowledge of fractions, it was easier for them to incorporate this into their art work.

Prior to painting the mural, the wall to be used for the mural was "tagged." Students were anxious and even though they saw graffiti every day in their neighborhood, this was the first time that it directly affected them.

Their interest in this wall gave us the opportunity to address social and political issues concerning the students' lives. According to Shor (1987) it is important that educators support these types of activities in order to bring real life issues into the classroom. Because students' saw this wall as theirs, discussions were held in class regarding graffiti, making students aware of some problems affecting their community. They took their concerns home and discussed these issues with their parents and relatives. Students came back to school with no answer to the problem and stated that they felt powerless. One student's solution was to contact his cousins who were gang members and ask them not to "tag" the mural. This was accepted by the students. I learned that the students knew little about how to deal with gang activity and how it affects their neighborhood. It did show the students, however, that a neighborhood is formed by many people who must work together.

Throughout the study students kept mentioning how much they were enjoying painting the mural. Art, as suggested by Christison and Bassano (1981), helped students develop a positive attitude towards mathematics. In addition, the mural gave them a purpose for studying fractions while they had "fun."

Painting the mural became a much more complex project

than students had expected. At first they thought they were going to be able to go outside and start painting. Soon they realized that it was not going to be simple. To do a project that large, they had to plan very carefully. First they divided themselves into groups and assigned a specific job to each member of the group. They made up a schedule. This experience taught students that in order to be effective, it was necessary to work in collaboration with others. Because of this collaborative effort, painting the mural became a joyful experience for all of the students as well as for me.

At first, students were sensitive about being observed while they worked. They felt uncomfortable watching me as I took notes. Later in the study they became used to this and often did not even notice what I was doing. The final written test was designed only for this group of students, as recommended by Cummins (1989). Students were asked to write questions they considered important for their test. These questions were later revised and used as questions for the final test. The class felt very familiar with the test and consequently did very well.

Chapter Review

Students were exposed to a rich learning environment where they were encouraged to become independent learners. The classroom was used as a safe place where students and

teacher work together to create knowledge, a place where students have an opportunity to discuss issues relevant to their own lives as well as concerns regarding subject matter content. Students often reflected on these issues and brought back ideas to be shared in class.

Understanding the value of mathematics and art within a society gave students a reason for learning both subjects. It was beneficial to integrate the study of fractions and art in the curriculum. Students at first complained that fractions were "too difficult" but were always willing to do art assignments. In this study students learned fractions through art which was considered the "fun" element of the projects. Subsequently, the designing and painting of the mural was viewed by all students as their final goal, giving them a purpose as well as a reward for their effort.

When asked, parents were as enthusiastic about this study as the students. Unfortunately, due to parents' lack of exposure to fractions as well as their many social responsibilities, very few parents participated. Mrs. Rodriguez mentioned that she had time to help in the classroom but did not speak English nor had she ever studied fractions. When asked, all parents interviewed except for one assured me that they would have attended parent education classes if Cèsar Chàvez Elementary School had offered them. It is recommended that parent education

classes be included as part of the research in order to maximize parent involvement in the classroom.

Reflections

Through this study, it was my intent to teach mathematics and art to culturally and linguistically diverse fifth grade students. However, towards the end of the study it became clear to me that the students had learned much more than mathematical and art concepts. The group developed organizational skills, improved their cooperative thinking skills and were able to view themselves as important members of society.

The need to be organized became apparent when students started painting the mural. They all wanted to paint at the same time, causing many difficulties among the students. In some instances students spilled paint and misplaced and broke materials. It created confrontations among those students who always wanted to be leaders, while the others watched their peers argue, waiting for someone to tell them what to do.

Students kept asking me to solve their problems, but I refused, explaining that I was there as a co-learner and that we had to work together. One student asked, "Why don't you tell us how to do it if you are the teacher?" This showed that most students were not used to being active

participants in their own education as recommended by Freire (1968).

This chaotic experience helped students realize the importance of careful planning. Mario first suggested we divide the class into groups, giving a job to each member of the group. Once everyone had agreed to this, Maria, one of the leaders, felt groups needed to take turns painting to "avoid getting in each others way." Every detail after this incident was discussed and approved by everyone in class. On some occasions students decided to revise the original work-plan in order to be fair to all students. Once everyone was satisfied with his or her assignment, there were fewer confrontations between students, thus helping them become more effective.

The difficulties students encountered at the beginning of the study provided an opportunity for the class to discuss the importance of cooperative work in the classroom as well outside the classroom. Some students argued that they felt comfortable working by themselves. The majority, however, believed that working in groups "made work easier and fun." Most of the students showed evidence of having worked in groups previously. Most students agreed that they had no experience organizing their own groups.

Students developed critical thinking skills that helped them throughout the study. On one occasion, students were

asked to write a list of responsibilities for the teacher and another for students. Students gave a variety of answers to these questions but at first most believed that the teacher's main responsibility was to instruct the students, and the students' responsibility is to learn the material being taught. No one viewed students and teachers as partners who work together to create knowledge.

Students' opinions changed slowly throughout the study. The less power I exerted, the more empowered students became. When they realized that I would not solve their problems alone, they became more vocal. Students were willing to discuss issues regarding the class as well as their community. For some students it was the first time they considered graffiti and its effects in a community. They were afraid that their work, the mural, would be vandalized. Students see graffiti all of the time around their neighborhood and at school. For the first time, however, they felt vandalism could affect them personally. This made them aware of the importance of becoming involved in the community. They talked about working together to stop gangs from destroying their community and to organize programs to prevent vandalism in general. It was surprising to see how the class changed from passive to active learners as encouraged by Freire (1970).

Changing behaviors was not easy for the students.

Initially they found it difficult and time consuming to investigate and to experiment. Slowly, and after many discussions, I realized that students were very capable of solving problems like the ones they encountered during this study. They had never been given the opportunity to do it. According to students, in the past they had been told what to do, how to do it, and when to do it. For many students this was the first time they felt their suggestions and concerns were taken seriously. This gave them a feeling of belonging.

Designing and painting the mural became their project and I was there to help them achieve their goals. This was the feeling many students shared with me at the end of the study. At this point, I realized that they had acquired complete ownership of the mural, making them proud of their work and who they were. A positive attitude was demonstrated by the students across the curriculum. I must say that I am very proud to see how these young students flourished at the end, becoming outgoing and responsible young citizens able to think critically, engage in problem identification, and take action to resolve problems.

As my students walked towards me to receive their diplomas I thought about the short speech I was about to give to parents at the promotion ceremony. I had planned to tell them that I was sad to see their children go to middle

school and that I wished them the best. When it was time for me to talk I was experiencing the same feelings. I was feeling sad that they were not going to be with me anymore but also happy because I knew how much they had learned. As I started my speech, however, I realized that what students had learned about mathematics, art, language arts, social studies, and other subjects was important, but there was something else they had learned that was just as important. This experience provided them with the opportunity to change as people. They came out of their egocentric world they were living in at the beginning of the year to see that they constituted an important part not only of their community but of the world.

At the beginning of the study students were unorganized, always wanted to be told what to do and how to do it. Their creativity was limited. As they became more confident their creativity increased to a level that I had never imagined it could. Slowly they learned to work with others, becoming partners united by a common goal. At the end they had developed organizational skills that helped them plan their work as well as their duties within the group. As part of these duties, students learned to take turns and to calmly discuss issues that were important to the group and not only to themselves. In addition they learned to identify, discuss, and understand how some social

issues affect them and their community.

I feel we all learned a lot from this study; however, there is a lot more to learn. Our second language learners will be at a disadvantage in our educational system unless we recognize their culture and their language. Educators need to see these differences among students as an open bridge that brings richness into our classrooms and our lives.

References

- Arian, E. (1989). The Unfulfilled Promise. Philadelphia: Temple University Press.
- Baroody, A. (1989). A Guide to Teaching Mathematics in Primary Grades. Boston: Allyn and Bacon.
- Beyer, L. E. and Apple, M. W. (1988). The Curriculum. Albany: University of New York Press.
- Biehler, R., and Snowman, J. (1990). Psychology Applied to Teaching. Boston: Houghton Mifflin Company.
- Bishop, A. (1988). Mathematical Enculturation. Boston: Kluwer Academic Publishers.
- Buchwalter, A. (1992) Culture and Democracy. Boulder: Westview Press.
- Cass, C. (1988). Modern Murals. New York: Watson-Guptill Publications.
- Cocking R., and Mestre, J. (1988). Linguistic and Cultural Influences on Learning Mathematics. New Jersey: Lawrence Erlbaum Associates Publishers.
- Cummins, J. (1989). Empowering Minority Students. Sacramento: California Association for Bilingual Education.
- Daniel, V. (1990). Art, Culture and Ethnicity. Reston, Virginia: National Art Education Association.
- Davies, N. (1974). The Aztecs. New York: G.P. Putnam's Sons.
- De Micheli, M. (1968). Le Grandi Monografie. Italy: Fratelli Fabbri Editori.
- Delgado, Gaitan, C. (1990). Literacy For Empowerment. New York: The Famler Press.
- Desmon, L. G. (1989). A Dream Of Maya. New York: Lawrence G. Desmond.
- Doll, W. E. (1993). A Post-Modern Perspective on Curriculum. Columbia: Teachers College Press.

- Durham, Q. (1981). Supermath. Washington: Special Child Publications.
- Enright, S., McCloskey, M. L. (1988). Integrating English. Palo Alto, California: Addison-Wesley Publishing Company.
- Freire P. (1970) Pedagogy of the Opressed. New York: The Continuum Publishing Corporations.
- Gallenkamp, C. (1976). The Riddle and Rediscovery of a Lost Civilization. New York: David McKay Company, Inc.
- Geertz, C. (1973) The Interpretation of Culture. New York: Basic Books.
- Gheverghese, G. (1993). Multicultural Mathematics. New York: Oxford University Press.
- Grant, C. (1991). Culture and Teaching: What Do Teachers Need to Know? Teaching Academic Subjects to Diverse Learners. New York: Teachers College Press.
- Helm, M. (1941). Modern Mexican Painters. New York: Harper and Brothers Publishers.
- Hurlburt, L. (1989). The Mexican Muralists. Albuquerque: University of New Mexico Press.
- James, A., and Jeffcoate, R. (1981). The Schooling in The Multicultural Society. London: Harper and Row Publishers.
- Kan, M., Meighan, C., Nicholson, H.B. (1970). Sculpture of Ancient West Mexico. New Mexico: University of New Mexico Press.
- Kennedy, M. (1991). Teaching Academic Subjects to Diverse Learners. New York: Teachers College Press.
- Kennedy, L. and Tipps, S. (1991). Guiding Children's Learning of Mathematics. California: Wadsworth Publishing Company.
- Kincheloe, J. (1991). Teachers as Researchers: Qualitative Inquiry A Path to Empowerment. New York: The Falmer Press.
- Kliebard, H.M. (1988). Fads, fashion and rituals: The

- instability of curriculum change. In L, N. Tanner (Ed.), Critical Issues in Curriculum: Eighty-seven yearbook of the National Society for the Study of Education. Chicago: University of Chicago Press.
- Lessow-Hurley, J. (1990). The Foundations of Dual Language Instruction. New York: Logmann.
- Loewenberg, D. (1991). Teaching Mathematics for Understanding: What Do Teachers Need to Know About Subject Matter? Teaching Academic Subjects to Diverse Learners. New York: Teachers College Press.
- Markun, P. M. (1983). Central America and Panama. London: Franklin Watss.
- McCaleb, S. P. (1994). Building A Community of Learners. New York: St. Martin Press, Inc.
- McDairmid, W. G. What teaches Need to Know About Cultural Diversity: Restoring Subject Matter to the Picture. Teaching Academic Subjects to Diverse Learners. New York: Teachers College Press.
- McKissack, P. C. (1985). The Maya. Chicago: Childrens Press.
- Netzer, D. (1980). The Subsidized Muse. Cambridge: Cambridge University Press.
- Nieto. S. (1992). Affirming Diversity. New York: Longmann.
- Olsen, L. (1988). Crossing The Schoolhouse Border. San Francisco: California Tomorrow.
- Pasztory, E. (1976). The Murals of Tepantitla, Teotihuacan. New York: Garland Publishing, Inc.
- Peregoy, S. F., Boyle, O. F. (1993) Reading, Writing and Learning in ESL. New York: Longmann.
- Pérez, B., Torres-Guzmán, M. (1992). Learning in Two Worlds. New York: Longmann.
- Pozetta, G. (1991). Education and The Immigrant. New York: Garland Publishing, Inc.
- Proskouriakoff, T. (1993). Maya History. Austin: University of Texas Press.

- Puckett, M. B. (1994). Authentic Assessment of The Young Child. New York: Macmillan College Publish Company.
- Ramos, S. (1935). Diego Rivera. Mexico: Imprenta Mundial.
- Rochfort, D. (1993). Mexican Muralists. New York: Universe Publishing.
- Rohmer, H. (1988). Atariba and Niguayona. San Francisco, California: Children's Book Press.
- Rohmer, H. (1987). The Legend of Food Mountain. San Francisco: Childrens Book Press.
- Shor, I. (1987). Freire for the Classroom. New Hampshire: Boynton/Cook Publishers.
- Schultz, K., Colarusso, R. and Strawderma, V. (1989). Mathematics For Every Young Child. Columbus: Merrill Publishing Company.
- Seidman, I. E., (1991). Interviewing as Qualitative Research. New York: Columbia University.
- Stepelman, J. (1993). Trends in School Mathematics: Curriculum and Teaching Standards Overview. Mathematics Teachers Resource Handbook. New York: Kraus International Publications.
- Stern, H. (1990). Fundamental Concepts of Language Teaching. Oxford: University Press.
- Thomas, D. A. (1991). Children, Teachers, and Mathematics. Massachusetts: Allyn and Bacon.
- Wilder, R. (1981). Mathematics as a Cultural System. New York: Pergammon Press.
- Young, B. (1990). Art, Culture and Ethnicity. Reston Virginia: National Art Education Association.