Family and Culture: Are Minorities Smart Enough to Learn Science?

by Sunethra Karunaratne
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This study investigated the influence that family and community cultures have on the teaching and learning of science in an after-school program. The Family Science Project provided an environment for third and fourth grade children to learn science with their parents, other adults, and middle school students. Sessions were held once a week for about one and half hours for 6-8 weeks in Fall and Spring semesters (1992-94.) The middle-school students, called the "Junior Scientists," assisted elementary children and at the same time learned science with them and with the other adults. The 20 participants were interviewed at the beginning of the program and at the end of one year. All the Family Science sessions were observed by the researcher taking descriptive field notes. Students' and parents' logs were also collected. Results indicated that self-esteem of children as well as their parents had gone up. The assistance given by the "Junior Scientists," and the opportunity to wear white lab coats provided a conducive environment for younger children to learn science and gain a positive image of themselves as "scientists." The interaction with the younger children helped the "Junior Scientists" develop a positive attitude toward science and meaningful science skills. The parents, who had poor images of themselves as scientists, were able to build up confidence and to develop positive images. They also believed that this intervention helped to direct their children to being more attentive in their science and math classes.

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Sunethra Karunaratne, a native Sri Lankan, was a Research Assistant at Michigan State University from September 1988 to August 1994. She obtained her B.S. in Chemistry, Botany, and Zoology from the University of Kelaniya, Sri Lanka, in 1971, then received her M.Ed. in Science Education from the University of Bristol, United Kingdom, in 1985. During the processing of this publication she was a sixth year doctoral student in the Department of Teacher Education at Michigan State University.

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Looking back at my past, I have tried to recollect what motivated me to learn science. I come from a family of 10 children. My parents were teachers who always considered our education a priority. Neither parent had learned science at the secondary level, but they always told us our future prospects would be good only if we learned science. At the time that I studied in the elementary grades science was taught as environmental studies and, from the sixth grade to the eighth grade, it was taught as general science. This included some chemistry, physics, earth science, and biology. After the eighth grade, students were selected to concentrate on science, arts, or commerce. My parents thought I was smart enough to learn science and wanted me to go into medicine. In order to do that I needed to get excellent scores in math and science during the final examination of the eighth grade. Even though my science studies did not ultimately lead me into medicine, I have remained in science as an educator. The questions I have today are very different from the questions I had earlier.

Now I am trying to understand why my parents considered science to be for the bright students. When I became involved in the Family Science Project I learned that it was not only my Sri Lankan parent's belief that science was for the smart people, but also the belief of parents that I interviewed in the United States. It seems to me that "Science is for smart people only" may be a universal belief.

As far back as 75 years ago, John Dewey emphasized that all students should receive a basic scientific education. But even today, most surveys show that children are either bored or intimidated by science lessons. This is even worse among minorities and female students. Rakow (1985) reports that a study done by the Minnesota Science Assessment and Research Project (1985) reveals that at age nine, Whites scored approximately 12% higher than Blacks or Hispanics. The National Research Council (1989) reports that females constitute 52% of the U.S. population, but that only 5% of American scientists are women. Entry into scientific careers is also poor for children from minority groups. All the minority groups compose 20.4% of the total U.S. population, and of those only 5% occupy the professional workforce.

Purpose of the Study

We believe that interest in science is most easily sparked in the elementary and middle school years. The Family Science Project used the assistance of parents, adults and middle-school students to help elementary-school children learn science. The Family Science Project that I studied was a part of the North Lansing initiative which occurred through a partnership between the Julian Samora Research Institute at Michigan State University and Cristo Rey Community Center. The Family Science Project in Lansing was a modified version of the National Family Science Program to develop a model to support science education for Hispanics and low income communities. The National Family Science Program developed by the Northwest EQUALS of Portland State University was designed to increase the participation of young women and minorities in science, mathematics, and computing. An innovation to, and modification of, the local Family Science Project from the national program was the use of middle school students as surrogate parents to assist elementary children, calling them "Junior Scientists." They helped children do the science activities.

Objectives

The goal of the project was to study the influence family and community cultures have on the learning and the teaching of science in school. The Project was designed to help children and parents develop science process skills, and to learn and enjoy science together. Engagement in hands-on activities helped participants to develop positive attitudes toward science, self-esteem in students as well as parents, thinking and science process skills, and skills for working collaboratively in groups. It was assumed that the understanding of science that they gained from the project would help in the continuation of learning science.

Theoretical Framework

The key assumption guiding this study was that the involvement of middle-school students and parents in the Family Science Project helped children to see themselves as capable of understanding science. This key assumption was based on several other assumptions:

* The cultural knowledge that the parents bring to the Family Science Project sessions helps developing socio-cultural congruency between home and school.

* The friendly informal environment encourages students and parents to engage in a discourse to come up with shared meanings to construct their own useful and relevant knowledge.

* Working in small groups with middle-school students and parents, help the young students to develop group working habits, such as listening to others, tolerance for discrepant views, and accepting others' ideas with understanding.

* Collaborative learning efforts lead to the development of positive attitudes toward science, and an understanding of science and science process skills.

Methods

The study used participant observations of Family Science sessions to understand the interactions among children, and children with adults and middle school students. The informal interviews with six elementary and four middle school students and their parents, before and after one academic year, helped us to understand their perceptions of the Family Science Project and their interest in the project. The participants' logs also helped us to get an understanding of their problems and their efforts to solve problems. Two science teachers of elementary and middle school students and the principal of the elementary school were interviewed to get their perceptions of the Project.

Overview of Family Science Sessions

The Family Science Project in Lansing was presented in two sessions, one in the afternoon and the other in the evening on the same day (Thursday) of the week for the convenience of the parents and children.

Afternoon Session: In these sessions (3-5 p.m.) middle school students — seventh and eighth grade children — worked with the younger children from the elementary school. The middle school students were called the "junior scientists." They wore white lab coats. They rehearsed science activities to be done on Thursdays on Tuesdays, so that they could assist the young children better with an understanding of the scientific concept. Each junior scientist assisted one or two young students. At the beginning we had four male and four female junior scientists. Two male junior scientists dropped out of the Project because they had to go to basketball practices on Tuesdays and Thursdays. On a typical day, people worked in four groups. Each group had a junior scientist and a parent to help three or four kids.

Evening Session: In this session (6-8 p.m.) parents worked with the younger children without junior scientists. An undergraduate education student from Michigan State University also provided assistance. She earned independent study credit for her participation in the Family Science Project. The attendance of the evening sessions was not consistent. Sometimes there were 12 students with 14 parents. But on average, about eight people attended each session. Two parents came with their children consistently.

The Family Science sessions were held in one of the kindergarten classrooms in an elementary school. A teacher from the middle school brought most of the junior scientists to the site. The others walked from their school to the elementary school, which took about 15 minutes. The Project Director brought some snacks and drinks for all the sessions. When the junior scientists arrived for the sessions they put snacks and drinks on one table and arranged the desks and chairs to work in groups.

Each day when the children (as well as parents) entered the room they had to sign-in on the Venn diagram and do an estimation. For one of the circles in the Venn diagram there was always a statement or question related to everyday life, e.g., "I am wearing blue," "I like snow," "Today is a humid day." The other circle always had a statement related to the science activity of that day, e.g., "Cold air is heavier than hot air." They knew that they could sign their names only once. Most of the time they made their choice by signing inside the circles or in the intersection of the two circles. It was a very rare occasion when a child signed outside the circles. We learned early in the pilot class that young children did not like to sign their names outside circles. The questions then were structured so that most children could sign inside. When a new child came, an elementary student guided the newcomer to sign in the Venn diagram. Sometimes when kids waited to sign-in for the Venn diagram they did an estimation. I observed that at those times when a child forgot to sign in, and remembered later, even while they were having their snack the child immediately got up to sign-in. Because of the interest they had in signing in, I asked the children what they learned from the Venn diagram. They said that it was fun to sign-in. They did not give me a reason why it was fun. One said, "Before we do the class we think it is not true, after it is true."

The second thing that all the participants had to do in Family Science sessions was an estimation. Generally the things to be estimated were inside a glass covered jar. After doing their estimation they wrote what they estimated on the front of a yellow sticker and put the name on the back of the sticker, and hung it on a line plot (usually) numbered from 0-250. One day they were given 76 mints in a closed glass jar to estimate. Their estimates ranged from 25-89 (25, 32, 33, 35, 36, 43, 45, 50, 50, 52, 60, 60, 65, 70, 70, 73, 89). They knew the actual number was written underneath the cover of the jar. Except for two or three times, they did not try to cheat.

The majority of the Family Science sessions were introduced by means of a problem or a content exposition by the Family Science Project Director — Dr. Rodriguez. In most cases, Dr. Rodriguez's exposition was interspersed with a series of questions which required short answers from the children. These served the purpose of maintaining children's attention and advancing the lesson in regular short steps. Generally they did about two to three hands-on activities a day, such as disappearing pennies or surface tension experiments with milk and food coloring. Sometimes one activity continued for two or three sessions, such as making hot air balloons and tee-shirt chromatography. At the end of the day, the Project Director discussed the scientific concept by asking for observations from the children and questioning those observations. Before they left the room they cleaned the area they worked in and washed and dried the equipment.

The analysis of the data collected will be described under the specific assertions made on the design of the Project.

Assertion-1

Hands-on activities in the Family Science Project make science enjoyable to children as well as parents.

All the Family Science sessions involved participants in doing hands-on science activities. Most of the time those activities could also be done at home with things available in the home. Hands-on science activities were done in groups. Junior scientists were distributed to all the groups so that all the elementary children could get assistance from them. Parents were similarly distributed. Group work, particularly that involving discussion, needs to take place in an appropriate environment. This was the main reason that the Family Science sessions were conducted in the kindergarten classroom where the desks and chairs could be moved. Neatly arranged rows of desks and chairs do not help to engender the relaxed and intimate atmosphere required for group dynamics. The social interaction in the groups led children to develop their thinking skills. For some of the activities (like building bridges) they had to figure out which model would work the best. In the group, each one had to defend her/his idea over the others to find the best design. While doing that, it was necessary to listen to others and come to a consensus.

Many children liked the activity of making racing cars from mouse traps. Each child got a mouse trap to work with. Junior scientists made their racing cars on the previous Tuesday. They prepared the axles by cutting dress hangers. For the wheels they used the bottle stoppers. At the beginning of the session the Project Director introduced the activity by asking the children to make their own design:

> *This is your design. See how far it goes, how fast it goes? At the rear axle you have to have some tape. Small wheels in the front and big wheels in the back or same size wheels or any combination… This is only a prototype.*

The first thing that they had to do was to remove the unwanted stuff from the mouse trap. Then they had to glue two popsicle sticks to the sides of the mouse trap. Before gluing the sticks they had to mark where the holes had to be drilled to insert the axles. As illustrated by the following narrative, this was a hard job for most of the children.

(JS = Junior Scientist)

> **Child**: I got to put my wheels.
> *JS*: See those.
> **Child**: My wheels are really crooked.
> *JS*: This doesn't.
> **Child**: I am still trying to put the things.
> *JS*: How come it doesn't stay? Maybe we didn't dry enough.

Junior scientists had to help the children in aligning the holes. The children who forgot to make holes in the sticks had to remove the sticks from the mouse traps to make holes. Even after gluing and putting on the axles and fixing the wheels, some cars didn't move. Junior scientists tried to help the children.

JS: Look
Child: You mess it.
JS: This thing goes fast. Make another one.
Child: No, I want to make it straight.
JS: No, look at that… Could you put this one in.
Child: Hm, hm, hm
JS: Now do this one. Oh! you did it. Now do this one.

Sometimes junior scientists had to figure out what was wrong in children's designs.

While walking around observing what the groups were doing, Dr. Rodriguez paid special attention to how junior scientists were assisting the children. She said quietly to one of the junior scientist who was doing it all, "Jose, you can't do it like that. That's not helping." Dr. Rodriguez did most of the gluing needed for the activity, because she did not want the children to use the hot glue gun. She walked around to see how children were working. Whenever she saw something to be corrected, she stopped and helped.

Dr. R: Wait a minute, before you put this you have to put glue. When you put this back you have to put it correctly. Which hole is for what?
Child: (from Dr. R) Is this even?
Dr. R: I don't know. The only way you can tell is when you put an axle.

All the parents who attended that day also made racing cars. They also helped the children while they were learning to make their own cars.

Mary: I need help.
Dr. R. What kind of help?
Mary: I need another wheel.
Dr. R. You need a string to pull.
Mary: Mummy, how do you do that? Mine is ugly.
Mary: Mom, are you going to make another one?
Mom: We already put the things together for you.
Mary: I want to do another one.

There were occasions where children helped their mothers.

Mom: I can't get this thing out of here.
Luz: I'll show you how to do it mom. Come on, you have to wait. Now pull it out. (mom tried to pull, but failed). I'll pull it out for you.
Mom: Ha, ha (laughing)
Luz: Do it mom. (mom tried it again). You are doing it wrong.
Mom: That's alright.
Luz: No it's not. (Finally mother succeeded)
Mom: Good, that's hard.
Luz: I want to see how it works?

When all of them finished making their racing cars, they took their cars to the hall way to start the race. Some cars went for a while and stopped. Some did not move for more than a foot. Some went for about 20 feet at high speed. When they saw the high speed cars they cheered and clapped without thinking who made those. I heard people saying, "It's fun, though it's hard."

When they had to wait for something, or the thing they were doing took a long time, they did not want to continue. For example, when they worked on hot air balloons they needed two sessions to finish. On the first day, when they had to glue the panels together, the younger children got bored because it took a long time. They wanted to finish right away and to send the balloon up. But when they finished and sent the balloon up they were so happy, and said, "That's fun." In general, it was not until the end that they really showed their enjoyment, although the parents were enthusiastic and engaged throughout.

Assertion-2

Science is fun and interesting. Any one can learn science and be a scientist.

At the first Family Science session we asked the participants to draw a scientist and to write about what that scientist was doing. We were very careful not to say the term "she" or "he". Except for one, all the children drew male persons as scientists. The girl who had drawn a female scientist said that she drew Dr. Rodriguez, because she thought that Dr. Rodriguez was a scientist. She further said that, "Scientists are younger women. They can be anybody. They are nice. They help people with stuff like (Dr. Rodriguez)."

When I asked them to draw a scientist while I conducted post-interviews, all except for one drew female scientists. Many drew their scientists with lab coats on.

The only person who drew a male scientist was a boy. We suspected that because the Project Director, myself, the teacher who brought the junior scientists, and the undergraduate who came to assist in the evening were all females, impacting on how they viewed themselves.

Many of them had drawn the scientists holding something. In the interviews when I asked "What is your scientist doing," most of them told me that the scientist was mixing chemicals. To them a scientist was a person who worked with chemicals and found new things. Even at the post-interview stage they wrote something about chemicals. When I asked them, "What kind of new things," they could not specify. At the post-interviews the same question was asked, "What do you think about scientists?" The responses of elementary students were:

* They explore a lot. They find new things. Probably they have a lot of fun.

* Nice people. Old and young people.

* I think they are really great. Because they got more brain than normal persons. They could be both women and men.

* They discover things. They try to find cure for illnesses.

* Really neat what they make up. They have coats like our junior scientists. They sit in the lab trying to figure out new things.

* Very interesting. They put on a coat like junior scientists.

Because they said some positive ideas about scientists, I wanted to learn from them what they wanted to be in the future, to get an understanding of whether they wanted to continue learning science. The following were their responses:

I want to be a scientist.
I want to be a teacher.
I want to be a lawyer.
I want to be a teacher, a brain surgeon.
I don't know what I want to be.
I want to be a scientist.

Of the six students, two wanted to be scientists, and two wanted to be teachers. The two who wanted to become scientists wanted to invent things. The two who wanted to be teachers said that they wanted to teach science. This shows that the younger children could be motivated to learn science by providing them with positive role models. For further verification of what kind of perception they had about scientists, I asked them whether any person can become a scientist. Their answers were:

Yes, anybody can be a scientist.
Yes, because they could be smart enough.
Yes, because even though scientists have more brains, but people have brains too, and there is little room for fun.
Yes, it is easy if you are interested.
Yes, if they listen.
Yes, because they don't have to be smart.

Although all six children said that anyone can be a scientist, the last person's response was different from others. When I tried to get some explanation, the child repeatedly said, "because it is easy."

The attitudes of mothers toward science was also changed. The following excerpts reveal how mothers thought about the program.

Mrs. Briones participated in the program because she did not learn science when she was a child. Her attendance was very consistent. She brought her two children to the sessions. She wanted to help her children learn science.

I participated because I didn't like science in school, and this would help me to enjoy in science and to help my kids in their education. We learned how to try and try it over. If one way doesn't work then we try another.

Rita was a fourth grader who did not have science in school. Rita's mother — Mrs. Arizmendi — wanted her daughter to have exposure to science. On the afternoons that she had off from work, she attended the Family Science sessions to help her child. She said that it enabled her to learn some science too.

I feel that it is interesting for me to give (Rita) support, so that she can do something to help her in the long run. I learned a lot, to do predictions, discovery. I didn't know the reason why hot air balloons go up.

Mrs. Martinez explained to me the barriers that existed when she was a child. She said that science was not even offered in her school. Her parents did not let her continue going to high school, and wanted her to marry at a very early age. She further said that at the time she did her schooling, there was no place for women and especially for minorities. It was believed that women should produce children. She had six children. Her youngest one was a girl and attended Family Science sessions with her.

Mrs. Martinez appreciated the Family Science Project because it was offered for free and she could study with the children. She sent two daughters to the Family Science sessions. The following piece from her interview transcript shows what she thought about the Family Science Project and how she changed:

> *The program being offered free… I learned a lot. Science that I know is from a newspaper or a book. Now I see different aspects. We do hands on activities. When we received the flyer saying Family Science class I had the question, **"Are we smart enough to learn science?"***
>
> *Now I feel that if I had the opportunity I would have learned science. There was no one to push me. I didn't have science in school. I thought you need high SAT scores to do science. The things you do even a first grader could grasp. A young child can really have the learning capability. That learning capability is higher than I thought. I thought science is for middle, junior and high school, but not for elementary. Teachers in the school should also teach with hands-on things. I am planning to take a science class in the community college. Motivation is important. I realized that I have the capability. I felt that I wouldn't be able to do it. But now I have the attitude. I read a book how to do experiments in science using inexpensive things.*
>
> *There is a big difference when you say something and reading a book or by doing a thing. I really like science. Science to me is a strong point. I didn't have it in school. I learned things I didn't know.*

All of the parents thought that their children had learned a lot and were motivated to learn more science because of the Family Science sessions. The following excerpts show what the parents expectations were and what they observed from the children.

Mrs.Arizmendi:

> *She enjoys. She always bugging me saying, "We got to do good." Now she knows about hot air. We took pictures. **She likes the project** and the things that she had done. **This year she seems to be outgoing. Last year she was a cry baby**. In the long run she will feel good about herself.*

Mrs. Briones:

> *(Sara) interested in Family Science. **Family Science would help her further interested**. I thought it would be fun. …They talked to the dad and showed what they had made and told what they learned. They are excited about going. They remind me on Thursdays that it is Family Science day.*

Mrs. Martinez:

> *They never would have realized **science would be fun**. They love to continue taking that class. Sometimes they remind me, "Today is Family Science." I feel that learning is important to them. **Now they like to learn science.***

Mrs. Velasquez came to Family Science sessions only once with her husband. They attended the evening session. According to Mrs. Velasquez, she took classes in the community college and could not come to the Family Science sessions. To get their perceptions of the Project I went to their home to talk to them. It was a very warm welcome, and both Mr. and Mrs. Velasquez wanted to talk to me.

> ***They like, always excited about what they learn**. Come home, do homework and play. They show us what they do in school. Usually while we eating we tell each other what we did. (Luz and Lucinda) interested in experiments.*

It was clear from watching the parents that they had many skills to impart to their children. They also demonstrated that they were learning the science that they had missed many years ago, and that their self-esteem had been improved as well.

There was also a positive impact in the classrooms of both the middle and elementary school children. The teachers observed that the students who attended Family Science sessions were more enthusiastic, responsive and involved in science activities.

Assertion-3

At-risk students can learn science and can be positive role models for younger children.

All the junior scientists were selected by Mrs. Lopez— the teacher who brought the junior scientists to the elementary school. According to her, they were at-risk students. Mrs. Lopez described to me the way she did the selection.

> *I basically went to the science teachers and asked them to recommend students — Hispanics high risk students that they felt would be benefited or interested in participating in the Family Science Program. A number of teachers gave me a list of names. I didn't know them. Then I showed the list to Dr. Garcia, the principal. He helped me select children from single parent homes who needed extra help in education.*

At the time the junior scientists enrolled for the Project, they were not definite about what they were going to do or whether they could do it. Rafael said:

> *I thought it will be hard learning that stuff. It was pretty easier and fun, because we had a lot to do, that I didn't even know.*

Belinda joined the Project two weeks later than the other junior scientists. She said, "I like working with other people. I really enjoy it. It is fun."

All the junior scientists said that they liked the program and learned science. Some especially mentioned working in groups with the children.

> *I learned to work in groups. I want to learn ideas from everybody. It was pretty fun to work with younger kids. They had their own decisions. I had mine. We discussed and worked together to see which ones are better.*

Some of the junior scientists wanted to try what they learned at the sessions at home, to show their parents, sisters, and brothers. Rafael was a good example. He said:

> *Sometimes whatever I learn over there, I felt like teaching over here. Because most of the things they do is household stuff and it's easier to do. I remember what my sister said when I did that food-coloring thing. She said that she never believed that it could happen.*

Mrs. Lopez also validated what Rafael said to me:

> *Rafael loves science and worked very well in the group helping the kids. I can remember he borrowed stuff to try at home, like food coloring when he needed. He wanted to show it to his sisters and brothers. It's good that they could try and do at home. Family Science motivated them to think.*

Although Rafael attended very consistently and supported the younger children, he was eventually forced to drop out of the Project. His father kept Rafael at home, suspended from Family Science sessions, to improve upon his schoolwork:

> *I know that Rafael used to like Family Science very much. He always wanted to be in it. He showed some of the stuff that he had made in Family Science, water, food coloring, and a lot of stuff, hot air balloons, and I can't remember… When he started falling behind the school work, I figured he would use Family Science time to do things in school… I needed him to dedicate more time to school work… I would have let him to continue Family Science.*

The parents of junior scientists were also impressed with what their children learned from the Project:

> *She has told me a lot of things, about kaleidoscopes, mirrors, and that you did with colors. She is always telling me about the project. She talks about Michigan State University and she feels that she learns.*

There were instances where the junior scientists thought that they learned from the children.

> *When we were doing straw things, we all had different ideas, except most of the things did not work. Kids have good ideas. Some of those are better than mine. When we were doing hot air balloons, Steve figured out a way to glue the panels in a fast way.*

Interviews with students revealed that junior scientists helped the elementary children a lot with hands-on activities and ideas.

* *They help you a lot. Its kind of fun. They help you count, and ask us to slow down when necessary.*

* *Its good to work with them because they know what to do. Parents also know what it is.*

* *They help me. They show how to do the activities.*

* *They talk to us nicely. Learn more in science, different things. Before you do it you feel that it won't work, but when they show us it works.*

* *They help a lot. Teresa helps a lot. Jose also helps, but I prefer Teresa, because Jose doesn't help that much. Teresa helped me to put the things to make the periscope.*

The elementary children expressed a desire to wear a lab coat and become a junior scientist one day.

> *Sara: I like to wear a one. It helps get out of chemicals. Lab coats help us to know junior scientists.*
> ***Luz**: White coats look like they are scientists.*
> *Lucinda: It is fun to wear them. They look like real scientists. I like to wear it one day.*
> ***Rita**: It shows that they are junior scientists. I like to wear because it gives a better look, excitement.*

Although the elementary children were waiting to wear a white lab coat, most of the junior scientists said they did not like the coat. They complained that it was hot to wear, but their behavior noticeably changed with it on. They walked more erect and acted more responsible when they wore them. Some had put a prefix of Dr. or Mr. on their name tags.

The elementary children's responses show us that junior scientists were able to do science activities with enthusiasm. Rafael was a student who thought that he could not do science. But later he found that it was fun and educational too. He enjoyed working with the younger students and with the parents.

According to Mrs. Lopez, Family Science also helped junior scientists to be more assertive as leaders. Some of the science teachers in the school told her that the junior scientists had taken the lead in doing most of the activities in the class, saying that they had done something similar in the Family Science Project.

Discussion

The junior scientists were identified as at-risk students by the school staff. Richardson et al. (1989) describes two models of at-risk students — the epidemiological model and the interactive model. The former refers to children through school related behaviors such as low grades, suspension, absenteeism, and so forth. The latter refers to children in relation to a specific social context, such as the interaction between the characteristics of the child and the nature of the classroom and the school. According to this model, a child who is at-risk in one classroom may not be an at-risk student in another classroom, due to the variations in teachers' perceptions of the child.

Richardson et al. (1989) have modified the interactive model by adding another concentric circle — the school district. They believe that although the school district does not directly effect the classroom, it may be quite powerful in the lives of students due to the decisions made by the district personnel on matters such as the organization of programs like bilingual and special education. When the child enters the social setting of a classroom, the child has to adopt the norms of that setting. The norms in a classroom are shaped by the teacher's beliefs about learning, student work, and the way they operate the classroom (Karunaratne, 1991).

It is clear that if there is someone to motivate the at-risk children and get them involved in hands-on activities, then the children will respond, not only by doing well, but also by understanding and enjoying the work. Our observations are further supported by Vygotsky's (1986) view that educational activity takes place within a zone of proximal development (ZPD) created by the learner and the teacher. There is a point at which the children can understand and work independently. Beyond that point, they could comprehend the material with an adult's guidance. When the adult and the child work together in the Family Science Project, the psychological function appears first in a social plane in the context of social interactions.

With the influence of the adult, children transform their cognition internally. Thus, the knowledge that children bring from their culture into the class is very important in cognitive development. When the children work with their parents in solving problems (like doing the hands-on activities in the Family Science Project) there is a high contribution of cultural knowledge onto the academic activities (Karunaratne, 1993b). This helps them to make bridges between the mainstream culture in the school and their lives and culture, and to develop an interest in what they are doing at school.

There is a growing body of literature referring to the importance of parent involvement in children's education (Karunaratne, 1994, 1993a; Delgado-Gaitan, 1991; Laureau, 1989; Bridgeman, Oliver, and Simpson, 1985; Bronfenbrenner, 1978.) Chapa and Valencia (1993) and Lareau (1989) point out that families living in poor socioeconomic conditions often face sustained isolation from the school culture, which might lead to miscommunications between school and parents. This miscommunication affects children's education through their parents resentment and apathy. As with Treuba (1994), when schools require participation of parents for school activities, parents of disadvantaged groups and minorities show minimal participation due to the disjunction of cultures between school personnel, the children they serve, and their parents. McCaleb (1994) says that the large institutional structure in the school intimidates minority parents. Due to cultural differences, parents do not feel comfortable participating in the school activities.

The profile of Mrs. Martinez provides many clues to designing a successful program in science. To her, the most important thing is the building up of courage. As reported earlier, she said, "*Now I feel that if I had the opportunity I would have learned science. There was no one to push me. I didn't have science in school.*" Mrs. Martinez thought that she would have learned more science, if there had been someone to encourage her. Because she was a woman, her father wanted her to stay home. Further she said that her father thought that the role of a woman was to produce children.

Walker and Rakow (1985) and (Kularatna and Karunaratne, 1988) report that males have more positive attitudes toward science than do females. This supports the perception that science is a field for males. It is interesting, then, that the attendance of fathers at Family Science sessions was so poor. Was it because a female scientist conducted the Project? Most mothers who attended Family Science recalled their unpleasant experiences in science while they were in school. All the mothers said that they did not have the opportunity to continue their education, and especially their scientific education. They had a fear of science (Karunaratne, 1994), but they wanted their children to learn it. This reveals the necessity of changing the negative attitudes of parents towards science.

Programs like Family Science help change at-risk student's behavior and increase their motivation in their educational endeavors. With the guidance of an adult, whether it be a parent, another adult or an older peer, children can be motivated and shown how to work collaboratively with others. According to "The 1990 Science Report Card," 26% of grade 12 students who took science reported that they never did experiments. It is very important to change their negative attitudes about science by letting them do experiments and make observations. Children should be able to build their own meanings to understand scientific concepts. Projects like Family Science which have a non-formal, group environment where adults and parents can assist children to build their own meanings, help increase children's interest in science and in doing hands-on activities. Non-formal science education projects such as this one enable educators to use a variety of influences to help students in learning science, such as motivation by peers, adults, and collaborative learning in group activities. This study will benefit researchers of formal and non-formal science education programs, as they plan for the diversity of students and parents in their schools and communities in developing strategies to encourage more children to select science. The results of this study would also be applicable in my own country of Sri Lanka, especially in rural areas, where the students are at a disadvantage in learning science (Karunaratne, 1991.)

Project 2061, initiated by the American Association for the Advancement of Science (1989), targets all Americans to increase scientific literacy. A study conducted by the Research Triangle Institute (1985) looking at the precollege scientific achievement of American youths and their counterparts in 16 other countries, shows that fourth and fifth grade children in the United States ranked below half of the other nations in scientific achievement. To achieve scientific literacy, it is necessary to offer other forms of education to supplement the formal school system. Non-formal programs are especially effective in dispelling the myth that "Science is only for smart people."

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