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Capturing Parents' Individual and Institutional Interest Toward Involvement in Science Education

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Abstract Parents are generally less involved in their children's science education (as compared to reading and mathematics) due to low self-efficacy and a lack of home-school communication. This study examined parental interest and attitudes in science as well as the nature of parent-to-child questioning during an interactive home, school, and community collaboration in the southeastern United States. Study results, compiled from observations, exit surveys, and interviews revealed largely positive family interactions and attitudes about science learning and increased parental interest toward involvement in elementary science. Parents frequently used productive questioning techniques during activities. These results imply that successful home, school, and community partnerships may elevate levels of parental participation in their children's science education and the parents' perception of themselves as being competent in assisting in science.

Keywords Parental involvement · Elementary science · Informal contexts · Science efficacy · Productive questioning

Introduction

The National Science Teachers Association (2009) encourages parents to become more involved in their children's science learning and it also encourages schools to promote effective parental involvement in an effort to increase students' interest

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and achievement in science. Research has shown that when parents are involved in their children's learning, children achieve greater success, regardless of socioeconomic status or ethnic/racial background (Catsambis 2001; Desforges and Abouchaar 2003; Jeynes 2005; Zellman and Waterman 1998). Unfortunately, it has been very difficult to actively involve parents in science programs and, once they are involved, to maintain this involvement after the program ends (Shymansky et al. 2000). Most parents agree with the underlying tenets that science is an integral part of everyday life; nevertheless, they are not as involved in their children's science education as they are in reading and math (American Association for the Advancement of Science [AAAS] 2001). Parents tend to have low levels of knowledge of what their children are studying in science at school (AAAS 2001; Cardoso and Solomon 2002; Solomon 2003). Reasons may be attributed to the parents' negative memories of learning science at school, as well as a their own lack of knowledge about the subject (Cardoso and Solomon 2002; Shymansky et al. 2000; Solomon 2003) and a lack of communication between school and home (AAAS 1996; Solomon 2003).

Research revealed that various factors, such as parents' perception of their role in their children's education and sense of efficacy, are important predictors of parental involvement (Eccles and Harold 1993; Hoover-Dempsey and Sandler 1997). This study investigated the influences of science exposure in an informal school context on parents' efficacy and interest in science. In order for positive science attitudes and learning to occur, support must be provided in the school context as well as in the home (Shymansky et al. 2000; Solomon 2003). Thus, a 'Family Science Night' initiative provided the context of the present study. Different from passive learning contexts such as museum visits, television viewing, or text reading, Family Science Night "… has sought to bring members of the public together in common purpose and to create a clear learning agenda" (Watts 2001, p. 84).

The university education program and local elementary schools partnered to frame the home-school collaboration. The event served as an instructional intervention aimed at introducing parents, caretakers, and children to cooperative inquiry-oriented science learning through positive, tangible science experiences by using familiar materials. The study addressed the following questions:

(1) What is the nature of parent-to-child questioning in an informal science-learning setting?
(2) What are the attitudes of parents toward science learning at the end of a home/school science initiative?
(3) What is the comfort level of parents in assisting their children's science learning after this event?

Background

A large body of educational research demonstrates a significant association between parental involvement and school success (Coleman 1991; Fan and Chen 2001; Gonzales-Pienda et al. 2002; Jeynes 2005; Shymansky et al. 2000: Van Voorhis 2003; Zellman and Waterman 1998). When parents become involved in their children's learning children feel more confident and interested in the subject at hand (Breakwell and Beardsell 1992; Fan and Chen 2001; Gonzales-Pienda et al. 2002; Shymansky et al. 2000; Simmons-Morton and Crump 2003; Turner et al. 2004). Miller (1989) stated that families "can socialize either a very positive or negative attitude toward science" (p. 177). Furthermore, parental involvement is an important predictor of career interest in math and science (Turner et al. 2004) and college enrollment (Catsambis 2001; Perna and Titus 2005).

Although it has been emphasized that students require exposure to science at all levels of schooling (National Academy of Sciences 2006; National Research Council 1996; National Science Board 2007), elementary teachers devote limited time to science teaching (Fulp 2002; Marx and Harris 2006; Weiss et al. 2001). The onus often falls on parents to introduce and support science in the home—which they do not often do. In fact, how parents are involved in their children's science learning seems an ambiguous area (Solomon 2003). According to Andre et al. (1999) study, parents believe that science is more important for older children and boys. It was stated that this perception might have serious effects on parental encouragement and involvement in younger children's and girls' science learning. In order to counteract this perception, elementary school programs that bring parents and children together in interactive and gender-neutral science contexts must be supported (Andre et al. 1999).

Parent's attitudes toward science, as well as their involvement with their children's science education, have been shown to be a predictor of student's science achievements (George and Kaplan 1998). However, many parents believe that they lack the knowledge necessary to assist in science learning (Cardoso and Solomon 2002; Shymansky et al. 2000; Solomon 2003). Parents who have negative attitudes about learning science in school tend to refrain from helping their children with science homework (Cardoso and Solomon 2002; Solomon 2003). Shymansky and colleagues exemplified the family's 'refrigerator door,' where children's science work is rarely displayed, as evidence of the under-representation of science in the home. Few tangible science projects take place in the home, relegating science to an infrequent topic of family conversation.

Along with their own individually-held beliefs, parents' perception of the general invitations and opportunities for involvement presented by schools is another predictor of parental involvement (Hoover-Dempsey and Sandler 1997). As Epstein (1995) asserted, "… most teachers and administrators are not prepared to understand, design, implement, and evaluate practices of partnerships with the families of their students" (p. 21). Without rigorous school effort to involve families in their children's education, parental involvement occurs only in some families (Sheldon 2003). Parents with low socioeconomic backgrounds are in particular jeopardy and tend to be less active on all levels of their children's learning (Lopez et al. 2001; Zill and Nord 1994). In fact, research has shown that when meaningful and hands-on contexts were provided (i.e., where families were allowed to work and learn together through manipulating materials), parents became more supportive of their children's science learning (Shymansky et al. 2000; Solomon 2003; Yore et al. 2005; Van Voorhis 2003; Watts 2001). For successful school, family, and community partnership programs, it is important to welcome all families in a non-threatening context, regardless of their background and socioeconomic status (Epstein and Jansorn 2004; Epstein and Salinas 2004).

In summation, research has demonstrated that parents' individual and institutional involvement levels are a result of a combination of their personal attitudes about science as well as a lack of opportunities provided by schools. In addition to parental interest and involvement, coordinated home-school efforts in science education have been limited (Shymansky et al. 2000). This study explored the nature of parent-to-child questioning and parental interest and attitudes about involvement in science education both during and after informal home-school collaboration.

Theoretical Framework

Two theories—Social Learning Theory proposed by Albert Bandura (1986) and Motivational Systems Theory developed by Martin Ford (1992)—shape the theoretical framework for this study. Bandura (1986) defines self-efficacy as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (p. 391). In other words, people with high self-efficacy beliefs are more likely to persist at tasks and apply more effort in overcoming challenges. Furthermore, Bandura (1986) posits that people are more likely to avoid tasks in which they do not feel confident. In order to develop self-efficacy, sufficient opportunities for practical and successful experiences are necessary (Bandura 1997). As applied to this study of parental science interest and involvement, Bandura (1997) describes a type of efficacy called School Collective Efficacy, which includes administrative support, student and teacher characteristics, and parental involvement. Parents require a positive self-image toward their acceptance of the parenting role in their children's education, as well as in their ability to interact with authority figures such as teachers and administrators (Bandura 1997).

Ford's Motivation Systems Theory (1992) expands on Bandura's self-efficacy construct by adding a perception of effective functioning construct. Ford asserts that individual efficacy and motivation beliefs develop through challenging, yet attainable goals. Personal "effective functioning" (p. 125) is defined as beliefs associated with capability and context. Positive parent perceptions of their role in their children's learning create fertile grounds for partnerships, bringing parents, teachers, administrators, and other agencies together with the interest in working toward a desired goal of student success (Ford 1992). From these theoretical perspectives, it is reasonable to consider that the effect of a positive science learning experience on parent proclivity toward school science involvement should include the learning context in terms of meeting adult needs and expectations.

Method

This study utilized data collected from two large-scale family science events facilitated by a university teacher education program. Social learning perspectives framed the study's effort to determine parents' individual and institutional interest in their children's elementary science education. In order to capture the effects of science learning participation, the study focused on parent responses after attending a 2-h Family Science Night.

The Intervention: Family Science Night

The Family Science concept is a pragmatic approach to science education programs that introduces parents, students, and other family members to science concepts and provides adult-child co-learning opportunities. Framed in the discovery learning ideals and the theories of John Dewey and Jean Piaget, the Family Science concept asserts that children learn science concepts through active involvement which, in turn, provides meaningful learning. Family Science employs the use of minds-on/hands-on experiences and 'discrepant events' that reveal unexpected outcomes that are often counterintuitive to previous knowledge structures. Discrepant events challenge students' alternative conceptions, try to resolve conflicts, and encourage conceptual change and understanding (Tsai 2000). Through the provision of demonstrations, experiences, and interactions using familiar items participants gain correct understandings and make tangible applications to their unique perspectives. Based on the assertion that attitudes and academic achievement in science are strongly influenced by caretakers (AAAS 2003), the concept of Family Science offers opportunities to mitigate caretakers' negative ideas, beliefs, and fears about science teaching and learning while increasing science concepts understanding in a non-threatening environment. Parent groups report a preference for tangible activities to become involved in their child's educational experience (Daisey and Shroyer 1995).

Arranging and planning a Family Science Night consisted of (a) assembling science event presenters; (b) presenting a workshop; (c) providing for events and materials; and (d) conducting the event (Lundeen 2005). As a key feature, Family Science used parents as co-learners and co-teachers in science. During the 2-h introductory event, informal settings were designed to promote conversations and questions among all age levels. In informal settings, learning opportunities are not fixed or overt. Learning takes place at each participant's own pace and accrues from a range of materials and activities. Participants have the opportunity to choose learning conditions (Watts 2001).

Prior to Family Science Night, activity presenters (consisting of home, school, and community member volunteers) attended instructional workshops where they selected a discrepant event to conduct with the participants. Presenters were instructed to encourage active involvement and implement productive questioning techniques (Elstgeest 1985). During the event, families freely moved around utilizing a checklist of event locations and titles. No requirements or specified activity agendas were imposed on participants; however, throughout the night, they were encouraged to visit all activity stations.

Context and Participants

During the 2005–2006 school year, two elementary schools in different areas of the southeastern United States agreed to implement a Family Science Night initiative with the support of a university teacher education program. The schools operate in the same state and adhere to parallel curricular mandates, but are distanced by geographical location. School A resides in proximity to the research university and School B is located 400 miles to the south of School A. No relationship exists between the schools. Administrators of both schools reported that opportunities for parent science involvement prior to Family Science Night had been limited to non-interactive annual science project demonstrations. School demographics reveal somewhat divergent population distributions and mirror each community's demographics, respectively. At the time of study implementation, School A reported a total population of 542, with a breakdown of 55% Caucasion, 33% African American, 4% Asian, 3% Hispanic, and 5% multiracial. School A is a public science magnet school whose student population is governed by school district geographical zoning borders. School B reported a population of 527, which breaks down as 30.4% Caucasian, 31.4% African American, 28.4% Hispanic, 6.9% Asian, and 2.9% multiracial.

The unit of study is defined as parents or primary caretakers attending the Family Science Night. Parent attendance was recorded via parent sign-in sheets provided at the event entrance and included a count of children as well as adults. School A reported 363 total participants (236 children and 127 adults) and School B reported 402 total participants (301 children and 101 adults) on the respective event nights. According to the collective parent sign-in sheets, <30% of adult participants were same-family parents. An approximately equal number of men and women participated in both schools' events.

The Family Science Night events took place during the after-school hours (6 p.m.–8 p.m.) for the convenience of working parents. Each event was announced well in advance through mass distribution of school flyers by both school administrators and teachers, and the events took place in the schools' campus cafeteria areas, which provided outdoor access. Both schools' principals and assistant principals attended the Family Science Nights. Classroom homework passes served as student attendance rewards. School A held 45 discrepant event stations, while School B provided 37 stations for students' and their families' active engagement throughout the designated time period. The discrepant event activities were compiled from university course materials, Activities Integrating Math and Science (AIMS), and over the internet (i.e., www.stevespanglerscience.com). All activities were tested by presenters before the event night. The university was responsible for the funding of the events. Activity materials were purchased prior to the events and distributed to presenters. A list of discrepant event activities is presented in Table 1.

Presenter groups for the Family Science Nights differed at the two schools. School A presenters consisted entirely of elementary pre-service teachers who received science activity instruction in their science methodology classes. However, due to its significant geographical distance from the university, most pre-service

Table 1 Family science night activities

1. Alka-Seltzer rocket	24. Mystery of the sinking ice cube
2. Awesome dry ice	25. Name the mystery substance
3. Baby diaper secret	26. Patriotic density
4. Better butter	27. Pennies in a cup
5. Bouncing bubble solution	28. Quicksand science
6. Color wheel	29. Rainbow explosion
7. Dancing milk	30. Red cabbage chemistry
8. Do not open the bottle	31. Root watering crystals
9. Does it float or sink?	32. School spear-it
10. Drop on a penny	33. Silly putty
11. Fizz, bubble, erupt	34. Sinking soda surprise
12. Floating water	35. Smell to tell
13. Flying ping-pong balls and toilet paper	36. Some like it salty
14. Hidden massages	37. Sorda pop
15. How does air move?	38. Square bubbles
16. Hover crafts	39. Straw through potato
17. Icing it over	40. Swinging bears
18. Ivory soap science	41. The color wheel
19. Laser light	42. The egg and the bottle trick
20. Lemon suds	43. Ultimate eruption
21. Liquid densities	44. What is magnetic force?
22. Make your own fire extinguisher	45. Where germs live
23. Money in a blender	

teachers were not available to participate at School B. Therefore, presenter groups at School B consisted of high school students who were completing service hours for graduation, teachers, university instructors, and community members (i.e., museum docents). The principal and science teachers at School B identified presentation volunteers through flyers and phone calls.

Presentation of each activity lasted a few minutes and was repeated several times during the night for small groups of parents and children. A variation of Bybee's (1997) *Learning Cycle Model* with three phases was used during the presentation of discrepant events. The Learning Cycle Model aims to activate reasoning and critical thinking skills in learners (Bybee 1997) and has been used successfully over a decade. First, in the *Exploration* phase, presenters confronted participants with questions or problems through discrepant events. Verbal descriptions were encouraged to reveal possible misconceptions. In the *Explanation* phase, participants resolved problems by relating to their science knowledge or through the presenter's assistance. Finally, in the *Expansion* phase, participants engaged in the activity by trying it themselves to ensure understanding of the scientific concepts and to relate it to their world. Examples of activities are presented in Table 2.

Table 2 Examples of family science night activities (adapted from stevespanglerscience.com)

Activity description	Materials
Alka-Seltzer rocket: Add carbonated soda to a film canister with one Alka-Seltzer® tablet, snap on the lid, and observe. The carbon dioxide gas builds up and snap opens the lid which usually makes a loud noise. When Alka-Seltzer® tablets combine with carbonated soda, carbon dioxide is released	35 mm film canisters with snap-on lids (clear canisters for viewing of the chemical change), Alka-Seltzer® tablets (one per canister) safety goggles, timer or watch, paper towels
Quicksand science: Mix cornstarch and water in a large bowl until you get the consistency of honey. Sink your hand into the bowl of "quicksand" and notice its unusual consistency. When mixed, cornstarch is finely divided and dispersed in water acting like both solid and liquid. This is an example of suspension	One box of cornstarch (16 oz.), large mixing bowl, water, spoon, newspaper to cover the floor, food coloring
Sinking soda surprise: When you place a can of diet soda and a can of regular soda in a large container filled with water, diet soda floats while regular soda sinks. Diet sodas usually contain aspartame, which is used in smaller amounts compared to sugar used in regular sodas. There is a little bit of space, above the fluid in each can of soda. There is more space in diet soda can and when filled with gas, it is just enough to make them float	An assortment of unopened soda cans (diet, regular, brand name, generic), a large, deep container of water like an aquarium
The egg and the bottle trick: Have an adult set the strip of paper on fire and put it into the bottle. Cover the mouth of the bottle with a hardboiled egg. In seconds, the fire will go out, and the egg will get pushed into the bottle. When the flame goes out, the heated air molecules in the bottle cool down and move closer together. The air pressure outside the bottle pushes the egg into the bottle	A wide mouth juice bottle, hardboiled eggs, several strips of paper, matches

Data Collection and Analysis

In order to elicit knowledge and beliefs that could accurately portray parent attitudes, data was collected through multiple sources (Bogdan and Biklen 2003). Family unit observations, parent exit surveys, and informal semi-structured parent interviews comprised the data. Both qualitative and quantitative data analysis techniques were used.

Family Unit Observations

Three researchers each randomly chose an individual family unit to observe and then recorded the events chosen, parent and child involvement in the event, comments and questions presented by the parent, and time on-task. In total, researchers conducted six individual family observations, lasting approximately 30 min in duration. The data set also included researchers' field notes and documented observations of vicarious parent–child interactions.

Researchers documented any questions a parent directed to their child during activity engagement, but were instructed not to interrupt parent–child interactions during science activities in order to preserve the integrity of the event. Parent-to-child questions were recorded as evidence of authentic science teaching and learning. Question content analysis was conducted in terms of their relevance to the science activity and categorized as 'productive' or 'unproductive', as suggested by Elstgeest (1985). According to Elstgeest, productive questions serve as prompts for action, exploration, and discovery learning. They stimulate children's mental activities and reasoning. On the other hand, unproductive questions essentially require a 'right' answer and they do not encourage learning. Elstgeet identified six types of productive questions: (1) Attention-focusing, (2) Comparing, (3) Action, (4) Measuring, (5) How and Why, and (6) Problem-solving.

Parent Exit Survey

At the conclusion of the event, parents and/or adult caretakers attending Family Science Night voluntarily completed a survey ($n = 158$). The survey included eight Likert-type items in addition to a 'further comments' item. Based on the literature of parental involvement in science, survey items assessed parents' attitude and interest in science as well as their support for future home-school science activities. The five-point rating scale indicators included the following markers: strongly agree, agree, neutral, disagree, and strongly disagree. All surveys were anonymous. Responses for each item were converted into percentages for analysis. Examples of the written comments were provided in the "Results" section.

Semi-Structured Parent Interviews

Parent interview content analysis comprised the third data set. Informal interviewing techniques were implemented during the second hour of each event, with 34 randomly selected parents, 17 of whom were male and 17 female. One-on-one interviews were conducted by several researchers at the conclusion of the families' visits. Interviews lasted only a few minutes and children and other family members usually stood by the interviewee or interacted with other families during this time. Questions were structured to elucidate themes pertaining to parents' experiences at the Family Science Night and their interest in science involvement. Researchers who interviewed parents were encouraged to expand the informal interview questioning for clarification purposes when appropriate. Parent interview questions are presented in Table 4. Descriptive codes identified through the question topic revealed commonalities among responses and certain themed groups (Bogdan and Biklen 2003). Several rounds of coding resulted in the emergence of specifically defined classifications. Interview responses to open-ended items (Q1–Q5) were tallied for content categories related to science teaching and learning. Descriptive responses to the interview protocol were coded and collapsed into naturally forming categories of similar content.

Results

Study results reported both descriptive and inferential views of the data. When combining both School A and School B data sets, significant similarities in parent responses were noted. Differences in presenter group composition did not appear to have affected parent evaluations or perceptions of the event. Although families stated that they enjoyed all the activities presented, based on informal observations and conversations throughout the night, *Alka-Seltzer Rocket, Quicksand Science,* and *Sinking Soda Surprise* were appeared to be the most popular activities (see Table 2).

Family Unit Observations

Researchers' analyses of their observations and field notes revealed a continuously high level of parental engagement with their children in the science activities throughout the evening. Of the six families closely observed during Family Science night, only one parent left their child momentarily while engaging in a science event, but they quickly returned and re-engaged after a refreshment break. The other five families observed were found to remain on-task and involved in activities for the greater part of 2 h. Of the 104 documented parent-to-child questions, the majority were determined to be productive in nature according to Elstgeet's six categories. Percentages of productive-type questions were calculated as follows: 40% Attention-focusing followed by 21% Comparing, 11% Action, 10% Measuring, 6% How and Why, 4% Problem-solving, and 10% Unproductive. Question content was found to focus on the specific activity in which the child was engaged. Parents' productive questioning was also noted to be accompanied by a strong focus on the child's interaction with science materials and events. Samples of recorded 'Productive' parent questions posed to children during science activities included:

(1) What's happening in the jar? (Attention-focusing)
(2) Which can is heavier? Why? (Comparing)
(3) How many toothpicks are in that jar? (Measuring)
(4) What will happen if we put more water in there? (Action)
(5) How do you think this happens? (How and Why)
(6) Can you find a way to sort these seeds? (Problem-solving)

Parent Exit Survey

Results of the Parents Exit Survey revealed that parents value science events and experiences for their children and themselves and believe hands-on science to be a worthwhile strategy in teaching science. Results also showed that 60% of the parents did not like science as students; only 20% percent reported that they liked science in elementary school (see Table 3). While parents unilaterally indicated that the intervention had been valuable for their families and that they supported more science teaching in their child's school (100%), not all parents reported an increased comfort level or interest in becoming more involved in their child's science

Table 3 Percentage response for the parent exit survey ($n = 158$)

Items	Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)
1. This experience was valuable for my child?	100	0	0	0	0
2. This experience was valuable for me?	100	0	0	0	0
3. I support science being taught in school more frequently?	98	2	0	0	0
4. I believe that teaching hands-on science is beneficial to my child?	87	13	0	0	0
5. I am interested in assisting my child's class or school with science?	89	3	8	0	0
6. I am willing to volunteer with the family science initiative?	70	20	7	3	0
7. This experience altered my comfort level in doing science at home?	71	9	0	20	0
8. I liked science when I was in elementary school?	10	10	20	48	12

learning. Furthermore, a few parents were undecided or unwilling to participate in future school science activities. In written comments, parents expressed the value of attendance, positive use of their evening time, and a need for repeated or similar involvement opportunities. Researchers identified a pervasive theme of enthusiasm for science teaching and learning. No comments were determined to be negative in nature. Samples of the written comments included:

(1) Science wasn't like this when I was a kid! This is so easy and enjoyable! Please do this more often. I am willing to help! I think this has been the best thing we've done at this school. Please do more.
(2) I have most of these materials at my house. We will do these things at home, for sure. Thanks!
(3) The turn out of parents and kids indicates a real interest in science. I hope our school will offer more science-related opportunities for parents to help with. It was great to see the kids learning and having fun.
(4) Whose idea was this to combine science with everyday stuff? It's about time! This has been so worthwhile for (my child) and for me too! I am so glad I came!
(5) This is wonderful!!! I've never seen him so engaged! I can't get him to sit down for 2 min and here, he hasn't stopped doing science for an hour!

Semi-Structured Parent Interviews

In general, parents believed science to be more enjoyable and 'fun' for their child than they personally experienced in school, and they particularly supported the hands-on component of the science learning (see Table 4). Many interviews

Table 4 Parent involvement interview analysis ($n = 34$)

Interview questions	Response categories	Response percentage (%)
1. What has your child learnt at family science night?	That science is fun	35
	How to 'do' science	26
	Science explanations of everyday things	24
	The importance of science in our lives	15
2. What have you learned about science education tonight?	Science is more fun than when I was in school	26
	Science is surprising	21
	How to 'do' science with my children	21
	That I like science done this way	17
	The importance of science in our lives	15
3. Do you feel comfortable 'doing' science at home?	Yes, I never thought of this as science	23.5
Why or why not?	Yes, if it's this easy to do	23.5
	Yes, my children would love it	21
	Yes, if I had the time, materials, and information	17
	No, I'm no good at science	15
4. How has family science night changed your attitude about science involvement?	Helped me think of science as hands-on	29
	Science is fun, not boring	26
	Made me want my child to know more about science	15
	Given me ideas to help my children	15
	Taught me the science of everyday things	9
	Found out how much I didn't know	6
5. In what ways do you support science being taught in the elementary school?	Taught hands-on	44
	Events like family science night	32
	Combined with real-life experiences	12
	Taught every day	12

relayed parental surprise at the user-friendly nature of the science activities. Parents reported an altered perception of what constitutes change (Q3, Q4) and indicated a willingness to 'do' science at home, as modeled by the Family Science Event (Q1, Q2, Q3, Q4). Some parent responses reflected an element of surprise at their level of comfort with science learning due to prior negative experiences (Q2, Q3, Q4). Despite the indication of overall enjoyment with the Family Science event, a lack of confidence in 'doing' and helping with science and a lack of science knowledge about everyday materials were evidenced for some parents (Q3, Q4).

Many parents stated recollection of negative science experiences in schools. When probed further with more pointed questions, these parents noted limited science understanding, failure in school science, and a general disinterest in science as reasons for their own lack of interest in science. Samples of parent interview quotations are offered as evidence:

(1) This is so much more than a fun night for parents and kids. It has shown us how easy it is to do science with our children. I DO want them to have many career opportunities, but because of my own poor science performance in school, I felt unable to support science learning at home. Now I feel I have the ability to help. It makes me feel good—like I can do more for my children.
(2) I hated science when I was in school! It was hard. It was painful! I didn't even want to come tonight! But this is great.
(3) We did very little science in school. I don't remember ANY science in elementary school. In high school it was boring.

Experiencing science in a hands-on method as related to everyday items and experiences, and the enjoyment of 'doing' science with their children, appeared to generate increased interest in science involvement. One respondent noted, "I have never been involved with science at school but would love to be! I had as much fun as my kids! I really think I could be a good science teacher!" A positive interactive family experience appeared to facilitate a sense of confidence in the parents' ability to contribute to their children's science learning. Evidence of parents' science efficacy is reflected in a positive comfort level with 'doing' science at home, supported by their own ideas. As one parent noted:

> We read a lot at home, but never do science. This has given me ideas about doing science at our house. But more to the point, I see how much my children love it. What parent wouldn't want to do science at home?

Furthermore, many parents were surprised by the easy access to materials used in the event. As one father reported:

> Wow, we never did anything like this when I was a kid! I think I would have really liked science if my teachers let me do this at school. I guess we are learning together tonight (be)cause I never knew half this stuff about things I use all the time!

Parents reported similar positive responses pertaining to their child's attitude from the experience, with the majority believing their children to exhibit a positive attitude about the learning experiences provided in the Family Science Night. Additionally, parents specified that minds-on/hands-on involvement with everyday phenomenon altered their perspective of science from 'boring' to 'fun.' The following parent comments are offered as evidence:

(1) My son never even mentioned science class before! It must be that whole "making learning fun" thing. I can see it works!
(2) This is creating a very positive view of science at an early age for my child. I am so glad. Hopefully she (child) won't dislike science in high school and college like I did.

Discussion and Conclusion

This study examined the nature of parent-to-child questioning and parent involvement and interest in their children's science learning during and after a home, school, and community collaboration. The study results were descriptive rather than evaluative and conclusive. Collective results obtained from the Family Science Night interviews and family observations revealed largely positive family interactions and attitudes about science learning for parents and children, increased individual interest in science learning, and an increased interest in parental involvement in elementary school science. Most of the parent-to-child questioning was productive and stimulating. Parents reported a high level of family engagement in the predominantly hands-on science events. Consistent with the findings of AAAS (1996, 2001) many parents stated that hands-on science is the most effective approach to science instruction. Specific responses to the individual interviews further supported parent perceptions of 'fun' as an important feature in science learning. This study's findings were similar to Watts' (2001) and Solomon's (2003) assertion that informal science programs enhance interest in and attitude towards science learning.

Participants noted the importance of science learning, yet reported less than enthusiastic personal recollections of their own science instruction. These results might be expected, considering the generally limited positive experiences of adults in science education (AAAS 2001; Cardoso and Solomon 2002; Shymansky et al. 2000; Solomon 2003). Such discrepancies emerged through the data collected on parents' personal science experiences and their ideas about their children's present experiences. Conversely, nearly all parents indicated a desire to break the cycle of non-interest and/or lack of proficiency in science subjects after experiencing science-friendly teaching and learning. Through this event, it can be concluded that parents were provided with much needed successful and practical science experiences, which play an important role in inducing self-efficacy as proposed by Bandura (1997).

Family Science Night was designed as a 'hook' for parents and a demonstration for the educational community of how children learn science in everyday life. In planning for the intervention, direct teacher involvement at both schools was deliberately avoided. Teacher participation and attendance was welcomed but not required. In planning Family Science Night, it was the researchers' concern that adding to the many tasks, initiatives, and responsibilities of elementary teachers could result in resentment and counterproductive outcomes. By aiming to introduce and involve parents with their children's science education, researchers hoped to set the stage for more fluid home-school science partnerships. As a result of their participation, parents' genuine interest with regard to parent science involvement sends a clear message to teachers. Sharing such findings with classroom teachers may open new avenues for home-school science collaborations. Study results indicate that a positive science context can set the stage for increased parental demand and support for science teaching and home-school initiatives. As stated earlier, effective science education programs are dependant upon early successful partnerships and positive interactions among home, school, and community (AAAS 1996, 2003; Epstein and Jansorn 2004; Epstein and Salinas 2004).

Through initiatives such as Family Science Night, science as a subject becomes recognized as deeply embedded in everyday life, rich in teaching and learning opportunities that are not exclusive to teachers. Similar findings when comparing the two Family Science events demonstrates the limited effect of presenter group compositions on study outcomes. These findings may lead one to conclude that the applicable nature of the science activities incorporating every day products and science concepts allows for successful involvement by both non-teachers as well as teachers. Additionally, although School A is designated as a 'science magnet school' (School B is not), parent event attendance and interest were comparable in both schools. Therefore, one may assume that parents are indeed interested in science as it relates to their children's learning, regardless of the school's curricular focus. Similar to previous research, when engaging, accessible, and meaningful opportunities exist, positive parental attitudes about science can be fostered (Shymansky et al. 2000; Solomon 2003; Yore et al. 2005; Watts 2001).

Unfortunately, this study was limited in terms of providing quantitative measures of understanding or relations with student outcomes. In fact, as Watts (2001) stated, measuring understanding in informal contexts where education and entertainment are intertwined is challenging. Nevertheless, it is hoped that events such as Family Science Night will encourage enthusiasm and excitement for science in home culture and in turn improve self-confidence for families, as was instigated in Solomon's (2003) study. Certainly, a night of science intervention does not solve the elementary science problem but, rather, provides a purview for change. Sustaining and making use of the elevated attitudes achieved through the event is the actual challenge. Watts (2001) indicates that there are strong barriers to be overcome in continued home-school partnership in science, such as pervasive aversion to learning about science in general and an internal reluctance of busy parents in attending functions at schools. Additional interventions, opportunities, and follow-up collaborations need to be implemented and evaluated in order to capitalize on parent involvement in science and ensure science learning gains for all children. In addition, since the unit of this study was specifically parents or caregivers, only parent-to-child questions were documented. The purpose here was to find out if parents were able initiate critical thinking in children through productive questioning regardless of their own background or self-confidence. A detailed analysis of child-to-adult questioning is recommended for future research.

The findings of this study tend to encourage the introduction of science in early grades and to encourage parental involvement through interactive opportunities. As AAAS (2003) affirms, families can make a big difference in their children's science education. Therefore, parents need to enter home-school partnerships with confidence in their ability to be effective science learning partners and with a desire for their children to know and enjoy science. As posited by Ford's Motivation Theory, positive parental perceptions regarding their role as a mentor and an understanding of educational opportunities may result in successful partnerships between the parents and schools, with common goals toward science learning and achievement. This study showcased how home, school, and community initiatives such as the Family Science Night can capture parental interest, induce positive attitudes, and alter perceptions of science in the elementary school setting.

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