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Mathematics in the Woods: Exploring Low-Income Parents' Perceptions of and Involvement in Their Children's Mathematical Learning

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Mathematics in the Woods: Exploring Low-Income Parents' Perceptions of and Involvement in Their Children's Mathematical Learning

Abstract

This article features data from a three-day mathematics camping trip that offered parents and their children time and space to enjoy non-digital activities and mathematics-building tasks. Drawing upon data from a larger qualitative study of children and their parents, this article specifically focuses on 10 parents' perceptions of their children's mathematics learning, problem-solving, and wellbeing. Findings suggest that, although parents are interested in their children's mathematics learning, they are most concerned with their children's development of problem-solving abilities and social skills. Moreover, students' own learning experience is important for their mathematics learning.

Keywords

math education, epistemicide, collaboration, community families, elementary school

Extant research suggests that parents 'attitudes toward math can influence their children's math achievement in various ways, from future career choices to "how children come to perceive their intellectual abilities and the value of learning and education" (Bempechat & Shernoff, 2012, p. 316). With regard to math learning, research on parent 'perceptions (Bleeker & Jacobs, 2004; Maloney et al., 2015; Mistretta, 2017; Zippert et al., 2017) and parental involvement (Vukovic el al., 2013; Strauss, 2013; Mistretta, 2017) revealed that parents 'positive perceptions and involvement can help support their children's academic performance. Furthermore, research has suggested that educating parents can help bring mathematics into their children's daily lives and enable them to perceive math as an interesting subject to learn. Building upon previous research that addresses parents ' perceptions of their children's mathematics learning in both after-school mathematics activities (Schussheim, 2004; Zippert et al., 2017) and in-school instruction (Bempechat & Shernoff, 2012; Bleeker & Jacobs, 2004; Sheldon & Epstein, 2005), this study examined parents 'perceptions of their children's mathematics learning skills and considers how parents 'priorities can shape their children's overall learning experiences.

Literature Review

This literature review encompasses four main parts: Piaget's theory of learning, parents ' perceptions of children's math learning, parents 'involvement in children's math learning, and family education in children's math learning. In addition to examining extant research of parents 'involvement and perceptions in their children's mathematical learning, I have applied Piaget's theory of learning as the theoretical and philosophical framework.

Piaget's Theory of Learning

From Piagetian theory, Ginsburg and Opper (1988) concluded that there are two explanations of learning. The narrow sense of learning (the specific sense of learning) is "the acquisition of new information or new responses restricted to a specific situation" (p. 208), and the broad sense of learning (the wider sense of learning) is developmental, and refers to "the acquisition of general thought structures which apply to many situations" (Ginsburg and Opper, 1988, p. 209). Thus, the information or knowledge is specific and cannot be generalized when children are learning in the narrow sense. However, in the wider sense of learning, children can generalize the acquire thoughts structures and transfer from one to another, and then the new learning experience has deeper effects than it in the specific sense of learning.

According to Piaget, development is the more fundamental process for children's learning " –development explains learning" (Ginsburg and Opper, 1988, p. 210), and children's experience is an important influence during the development. Hence, children's mathematical learning can be explained by their development in math. Furthermore, Piagetian investigators Inhelder et al. (1974) gave center stage to the role of children's activities in developmental learning. Therefore, children's mathematical learning can be developed in a wider sense by experiencing math in daily life.

Through "social transmission" and the way it influences children's learning, Ginsburg and Opper (1988) state that "social transmission may refer to a parent explaining some problem to a child, or to a child's obtaining information by reading a book" (p.218). Social transmission, then, promotes developmental learning. They further explain social development as:

> The accumulated wisdom of a culture passes down from generation to generation, and. enables the child to learn through the experience of others. Because of social transmission, the child need not completely reinvent everything for [one]self. The

> culture provides [the child] with extraordinary cognitive tools …. These tools enable [the child] to do mathematics, to speak, to write (Ginsburg and Opper, 1988, p. 219).

Moreover, in his theory of intellectual development, Piaget has identified children's "self-regulated development." Ginsburg and Opper (1988) explain that the child "takes an active part in his own development" when one "feels a subjective lack of certainty about [the] solution" (p. 236). Self-regulated development, then, influences "the external shaping responses and the modification of behavior" (Ginsburg and Opper, 1988, p. 237). Therefore, social transmission and self-regulated development echo children's social and emotional development within cultural contexts and one's well-being.

Parents 'Perceptions of Children's Math Learning

Current research suggests that parents can influence their children's math learning experiences, performance, and attitude. Mistretta (2017) explained that parental attitude toward math is important because "supporting children with math does not hinge on how much math family members know, but rather on the questions family members pose" (p. 193). Similarly, Bleeker and Jacobs (2004) have revealed that parents 'beliefs and attitudes about math can directly affect children's feelings about and interest in the subject: a "mother's early beliefs are related to older adolescents 'feelings of math-science career self-efficacy and ultimately to whether young adults pursue careers in certain areas of math and science" (p. 108).

It is not surprising, then, that parents 'attitudes toward and involvement in math learning can affect their children's attitudes toward and achievement in math (Maloney el al., 2015; Van Voorhis, 2010; Vukovic el al., 2013). Relatedly, parents 'positive feelings about math have translated into students 'positive mathematics performance; parents 'enjoyment in working with their children on math has led to "significantly higher levels of family involvement, more positive feelings and attitudes about math homework" (Van Voorhis, 2010, p. 1). Thus, parents should "foster high expectations for children's success in mathematics" (Vukovic el al., 2013, p. 446) because parents can impact children's math learning positively if they guide them to explore early math concepts (Zippert et al., 2017).

Parental Involvement in Children's Math Learning

Parental involvement has been identified as an important factor in the academic success of students (Lawson & Hodge, 2016; Sheldon & Epstein, 2010; Van Voorhis, 2011). Van Voorhis (2011) suggested that math homework can foster positive communications among parents and children when clear roles exist, when content is explained, and when the material is relevant. Similarly, Mistretta (2017) found that parents learned from their children how to solve mathematics problems. Helping their children with homework encouraged family members to participate in solving math problem with children at home, and family members approach to math problems "deepens everyone's understanding of the math involved" (p. 195). Overall, research suggests that formal and informal parent participation in math activities support their children's engagement and enjoyment in mathematical learning (Schussheim, 2004; Voorhis, 2010; Zippert et al., 2017). Hence, supporting parent participation with useful tools is an important part of children's mathematics learning (Schussheim, 2004; Zippert et al., 2017).

Family Education in Children's Math Learning

Vukovic and colleagues (2013) suggested that parental involvement is something that might require "policies and programs targeting parental involvement in mathematical skills…parents should receive training, resources, and support on culturally appropriate ways to create learning environments at home" (p. 462). Maloney et al. (2015) argued that parents provided with support and tools, such as structured activities, would "be equipped to positively affect their children's math achievement and math attitudes" (p. 1486). In other words, simply stating that parents should be involved is not enough; concrete steps to educate family members is needed.

Studies of family engagement in math have included math applications to daily life at home, presentations by parents in class about how they use math at their work, and special sessions dedicated to parents and children learning about math (Mistretta, 2017; Schussheim, 2004). Given that "children weren't motivated to learn about math because they didn't see its relevance in real life" (Mistretta, 2017, p. 195), such approaches could help children make important connections. Furthermore, Schussheim's (2004) focus on a math event for families suggests that sharing fun moments of mathematics learning can help to tighten the collaboration between the family and school and encourage parents to participate in their children's overall learning. Similar to Schussheim (2004), I have addressed family engagement in a math event—a camping trip—but primarily focuses on parents 'perceptions. In what follows, I have described the after-school program and the camping trip.

About the After-School Mathematics Program

In this article, I have focused on an after-school mathematics program located in a high-need non-public school in New York City. As an ethnically diverse and socioeconomically disadvantaged school, tuition and related fees are optional in order to accommodate economically struggling families. At any one time, up to 20 fourth, fifth, and sixth graders work together in a mixed-grades approach in the mathematics program. The program's mission includes helping students and their parents to build mathematical confidence and competence through solving problems. There are no exams or any other means of testing in this program. Instead, the emphasis is on participating in various math-related activities, such as designing mazes, creating songs, cooking. All these activities were conducted in the mathematics after-school program class during the Spring semester and culminated with a presentation at the camping trip.

Activity 1 -- Maze Designing

During the Spring semester, students in the program were placed into two teams by themselves—the third and fourth graders 'team and the other was the fifth graders 'team. In the first week, I showed several photos of mazes to students to teach them maze types, materials, and history of maze construction. I then asked students to deliberate about the information presented. In the second week, students watched two videos of "animals playing with mazes." They then discussed the various ways that animals solve mazes. Then, in teams, they tried to design their own mazes on paper. From the third to sixth week, two teams of students started to build their mazes with different themes and materials (stones, straws, and wood). In the last and seventh week of the "Maze Creating" project, two teams tested their mazes by using a small toy that could move itself through the maze. Lastly, during the camping trip, students demonstrated their teamwork in "Maze Creating"; they designed two mazes and explained their ideas for creating them as a team to parents. Artifacts used were stones, straw, wood, papers, pencils, pieces of cardboard and small moving toys.

Activity 2 -- Song Creation

The program teacher (a Ph.D. student with a popular music band) met students once a week and divided them into different groups to create the lyrics for the song of the program by themselves. The teacher used a popular song's rhythm to help students complete the lyrics to the song. The teacher choreographed the song and practiced it with students. At the conclusion of the song's completion, students performed in a singing and dancing show for parents during the camping trip. Artifacts used were papers, a speaker, and pencils.

Activity 3 – Cooking

The program teacher (a faculty member from my university) came to the program to teach students how to cook pumpkin bread and other foods. While cooking, students learned how to measure with measuring cups. During the camping trip, students baked pumpkin bread with the teacher for parents and others. Artifacts used were measuring cups, kitchenware, oven, flour, water, sugar, eggs, and milk. All of these activities required students to engage in mathematical thinking and the ability to complete tasks, which helped enable them to learn and improve their logical thinking, measuring, calculating, and estimating. (See Figure 1).

Figure 1

The Connection Between Math-related Activities and Mathematics Thinking and Ability

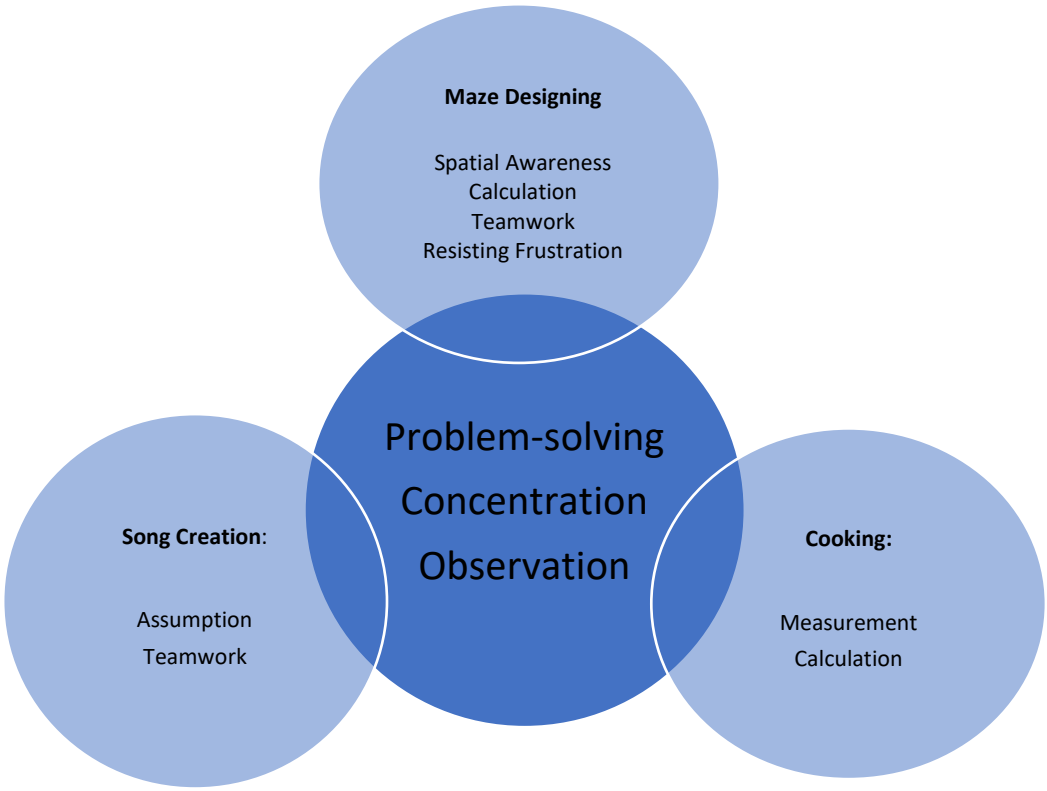


Figure 1 demonstrates possible connectionss between each mathematics-related activity and potential development of students 'mathematics thinking and skills. Maze designing, song creation, and cooking all connect with "problem solving," "concentration," and

"observation." Moreover, students were presented with the opportunity to engage in cooperating and collaborating with others to achieve a team goal. These math-related activities were designed by the program teachers, which were aimed to align with students ' mathematics development, stimulating them to learn and improve mathematics thinking and ability.

This program ran three days a week during the academic year (10 months). There were 10 teachers involved in this program, including five program teachers, two student teachers, one program director, one program coordinator, and one program contact from the host school. As a lead teacher of this program with two assistants, I taught three days a week in the after-school program (2:30 – 5:00 pm). The other program teachers conducted activities on a weekly or bi-weekly basis. In addition to individual and group student activities, the program featured parent meetings every four to six weeks, and all teachers met with parents about six times throughout the academic year. During these parents 'meetings, parents completed some of the same activities in which their children were involved, and the parents had the opportunity to share their thoughts about the program. Furthermore, students and teachers would share the camping trip itinerary with their parents at parent meetings. For instance, students presented their maze drafts at the parent meeting and shared their ideas of designing mazes with parents. Also, students showed parents how they understood the rhythm and the rules of the music by playing a music game together with parents and teachers at parents 'meetings. The music game was created and headed by the program teacher. By sharing ideas and playing the music game together, parents understood what their children were learning by communicating with them during and after the meetings.

All team members played various roles as they cooperated with each other to conduct the program and prepare for upcoming camping trips. Every team member had her own work content to process during the program. At the same time, everyone in the program stayed in communication with parents. In contrast to other after-school programs, this program intended to teach students skills of learning mathematics and other social skills instead of asking students to complete homework. The camping trip was built on a series of program activities during the semester and included additional nature-related activities that provided opportunities for parents and children to bond.

About the Camping Trip

There were two camping trips for parents and students each year, once in the Fall and again in the Spring. The camping trips took place in upstate New York, from Friday afternoon through Sunday. Parents were asked to avoid using digital devices and instead focus on communicating with their children and with others. In this way, parents would be immersed into the camping component of the program through understanding its ethos and purpose.

Only one parent from each family would bring their child and stay in a cabin with other parents and their children; two or three families live in one cabin. Parents and their children would discuss sleeping arrangements. Except for one student teacher, all other teachers attended the camping trip, and every family had one parent attend the camping trip with their child.

During the camping trip, the parents engaged in most of the activities with their children as a parent-child dyad. As a larger team, the parents and their children participated in many activities and games. These activities included an early morning walk, a nature adventure observation, a night walk around the lake, cooking, board game playing, and mathematics game playing. One example of a mathematics game was called "24 Game," when each parent-child pair tries to produce a combination of operations on all four numbers

on the game card so that the operations on these numbers equal 24 (i.e., addition, subtraction, multiplication, or division).

In addition, there was an activity especially for parents (without their children), wherein the program teachers talk to parents in groups and ask their opinions about math, education, and their expectations and hopes for their children. In this activity, parents play the main role in the conversation, and they express their own educational thoughts with each other and the teachers.

Methods

This article features data from a May 2019 camping trip focus group interview with 10 parents when they addressed their perceptions of, and involvement in, their children's math education. Prior to watching Sir Kenneth Robinson's (2006, 2018) TED talk about creativity and nature, parents responded to questions, such as "What do you want your kids to do in the school?" and "What does the after-school program mean to you"? After this discussion, the parents watched the TED talk, *Do Schools Kill Creativity* (Robinson, 2006), and then were asked to list the three most important things they wanted their children to learn in school. This 46-minute focus group interview was audio recorded and transcribed.

To analyze the data, I used inductive coding methods. To categorize the data, first, I read the transcription to understand the general information, and I used In Vivo Coding (Saldana, 2013) to categorize parents 'quotes, such as "self-control," "to be a good person," "problem-solving," and "math." Then I categorized these In Vivo codes according to their characteristics, such as math and other subjects learning skill, social skill, problem-solving abilities, pressure, parents 'perceptions, and respect. Furthermore, this study included observational data from the focus group interview. These observational notes, along with artifacts from the camping trip, helped to triangulate the data and ensure its credibility (Denzin, 1978).

Researcher's Positionality

As a mother, I teach my eight-year-old daughter mathematics in everyday life. For example, I ask her to count the trees on the side of the road or use her fingers to calculate simple mathematics when we are shopping or paying for something. I try to make math fun because, as a middle-school student in China, I had a difficult time learning mathematics. However, as medical professors, both of my parents believed mathematics was easy and fun to learn, and they had high expectations for my math learning. Even though I had a tough time studying math since middle school, I gained the beliefs from my parents: math is not that difficult, and I can learn it by applying effort. Similarly, I think children would think mathematics is too hard to learn if parents transfer fixed mindsets or bias about learning mathematics. The more significant point gained from my personal experience is that parents 'involvement and perception are important parts of a child's math learning and achievements, and these two factors could influence a child's math learning attitude and motivation.

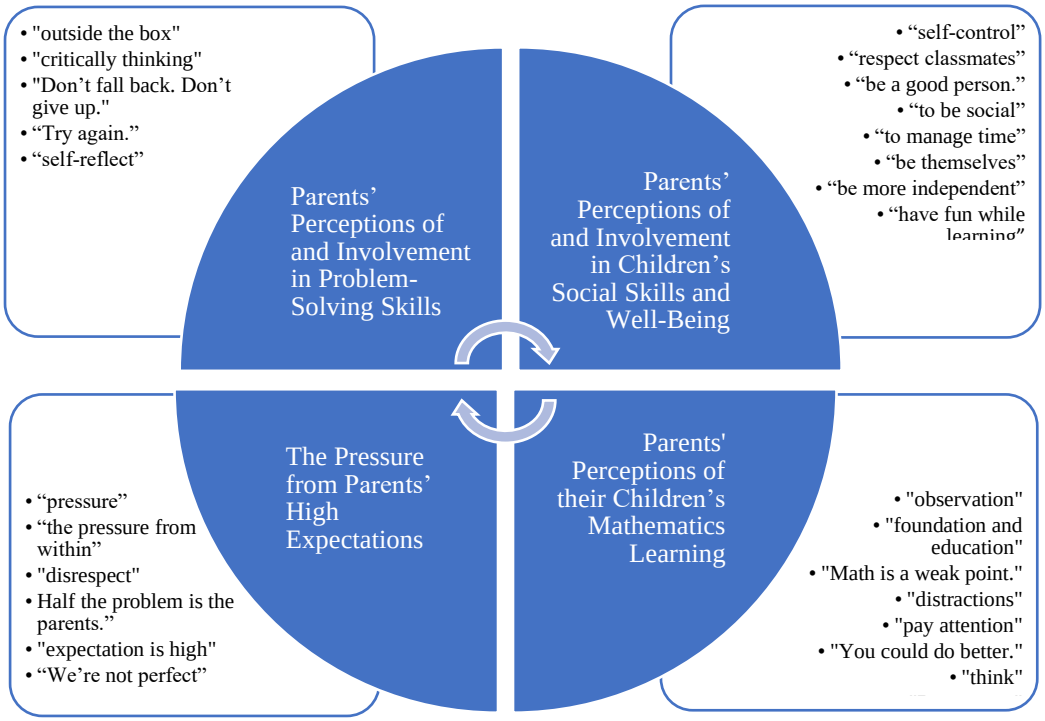
Findings

At the beginning of the interview, one of the parents was worried about sharing "wrong" answers even though she was assured that there was no such thing as a "wrong answer" and diversity in opinions was expected and welcomed. During the interview, parents spoke about their perceptions and involvement in children's problem-solving and social skills. There were four main themes for the findings: (a) parents 'perceptions of and involvement in problem-solving skills, (b) parents 'perceptions of and involvement in children's social skills and well-

being, (c) pressure from parents 'high expectations, and (d) parents 'perceptions of their children's mathematics learning. In what follows, each of these four dimensions are explored separately and then discussed together to call attention to parents 'perceptions in these four themes aroused by parents 'conversations (see Figure 2).

Figure 2

Four Themes with Parents 'Quotes



Note: Figure 2 shows the four themes that emerged from parents 'conversation, and each theme is supported by parents 'quotes. The words or sentences appear in Figure 2 because they are emphasized or repeated by parents during their conversation.

Parents 'Perceptions of and Involvement in Problem-Solving Skills

Parents explained that, in both school and the after-school program, they were hoping their children would gain problem-solving skills. Specifically, in the after-school program, they expected their children to learn math, reading or writing, but more importantly, they hoped their children would learn how to solve a problem in different ways. Two parents said they hoped the program would "teach them [their children] how to think outside the box" and "We want our kids to be able to think outside the box, or critically think." A third grader's mother shared with us a story concerning her son's excitement about how he learned how to cook by learning measurements in the after-school class. She said, "He was so excited. He was like, Mommy, I can measure everything, and he was able to measure everything. And he didn't realize that he was doing math." She continued, "he was like, 'I can't believe I learned it. 'It was so much fun that he didn't realize that he was actually learning." Her story underscored how math can be practical and fun to learn, and that the parents expressed a value they saw in the program: mathematics can be learned easily in daily life.

Another sixth grader's mother talked about problem-solving with regard to her daughter's experience with the flag football team. At first, her daughter was not selected for the team, and she encouraged her daughter go back and ask the coach again: "I think for the

first two times she failed…the third time finally the coach said okay." She said proudly, "She is so good now. See?" The other parents in the group interview joined in and agreed that one of the ways to solve problems is "Don't fall back. Don't give up" and "Try again." The parents believed that their involvement could positively influence their children. Additionally, one parent mentioned that the ability to "self-reflect" is also necessary for solving a problem.

Parents 'Perceptions of and Involvement in Children's Social Skills and Well-Being

Parents 'responses about their perceptions of children's social skills and well-being were a central part of the interview. The word "self-control" inspired discussion topics; parents spoke of hoping their children will have moral character. They all discussed key characteristics, such as "respect classmates" and "be a good person." They also hoped their children would have the skills "to be social" and know "how to manage time." Along with these points, parents were concerned with their children's well-being and hoped that their children will "be themselves," "be more independent," and "have fun while learning."

All 10 parents agreed that "self-control" is one of the most important skills their children need to learn. Two parents acknowledged how self-control is difficult to achieve, explaining "I've got everything but the self-control" and "We're all working on that one." Parents said they expected their children to learn how to control themselves so that their children would be able to learn to be "more independent." Parents 'expectations, therefore, became an important factor in their children's learning experiences.

The Pressure from Parents 'High Expectations

During the focus group interview, when parents mentioned their expectations, one parent brought up the word "pressure," and they agreed that parents 'high expectations put a lot of pressure on both children and teachers. They also acknowledged that the pressure is a drawback. One parent said, "In the expectation and the pressure being high… there are shortcomings." Parents also recognized that children's own pressures, "the pressure from within" also came from the parents 'high expectations.

Additionally, parents talked about how their high expectations could cause issues of disrespect in school, and explained that sometimes children can disrespect teachers because parents did not correct their children at home: "That kid is going to be disrespectful, and yet as a parent you don't correct that disrespect, then guess what happens? That kid feels that he could disrespect any adult anywhere at any time." Parents also believed that the pressure from their high expectations could transfer to their children and the classroom. One parent said, "I think half the problem is the parents," and another parent followed, "That's why I said that pressure starts from me, and then that pressure carries over to the teacher so that expectation is high." Parents also agreed that their children need to be supported and understood more, and they acknowledged, "We're not perfect."

Parents' Perceptions of Their Children's Mathematics Learning

Although parents realize their high expectations can bring pressure to children, they believe that their children could improve their mathematics learning in both school and after-school programs. Some parents sent their children to this program because they believed mathematics is their children's "weak point." During discussion, parents thought their children were better at other subjects than mathematics, and parents agreed that "distractions" are the reason for their children's "weak point" when learning mathematics. Three parents explained, "There are a lot of distractions." Parents believed that their children need to "pay

attention" so that they can continue "doing good." One parent told his son, "You have to pay attention. You need to get it right." According to parents 'conversation about "distraction," they believe that "paying attention" is an effective way to learn mathematics for their children.

Also, parents agreed that "thinking" and "reflecting" are helpful for children's mathematics learning. One parent said, "Our goal was not to have you change or to do anything, but to give you (child) the opportunity to sit, and think, and reflect." Another parent added "be positive" as an important element for children's mathematics learning.

Discussion

Students showed great interest in conducting all camping activities during the camping trip. The camping trip is a tradition and also a highlight in this after-school mathematics program. At the same time, students are learning new things. As Schifter (2005) stated, experiencing mathematics is the fundamental way one can understand the nature of mathematics: "to 'do ' mathematics is to conjecture – to invent and extend ideas about mathematics objects." (p. 85). Schifter suggested that building up students 'individual ways of knowing is important for students 'learning, and their own culture and experience is the essential part of learning development. (Schifer, 2005; Ginsburg & Opper, 1988). Moreover, experiencing arts can help students see more and hear more, and they "may gain a sudden sense of new beginnings." (Greene, 1995, p. 123).

According to Piagetian theory, Ginsburg and Opper (1988) stated that children's knowledge learning "must be discovered and constructed by the activity." (p. 14). Therefore, teachers and educators need to respect students 'natural experience of learning, and encouraging students learn math by experiencing it, rather than simply instructing them mathematics curriculum. Furthermore, bringing arts "offers the prospect of discovery" (Ginsburg and Opper, 1988, p. 133) to mathematics teaching and learning.

Nonetheless, there is an underlying tension: parents want their children to show discipline and yet be able "to do whatever" they are happy with. Sometimes these two notions are not easy to reconcile, even for adults. Indeed, parents 'tension comes from their understanding of learning. As mentioned above, in Piaget's theory of learning, children cannot transfer one situation to another when they are within the narrow sense of learning. However, they "can learn from the world and come to understand reality" (Ginsburg and Opper, 1988, p. 210) when they are learning in the broad sense. Hence, parents 'tension can be relieved if they realize that children's developmental learning is not only from textbooks, but also from activities and initiatives.

From a Piagetian perspective, "self-control" is an important term that refers to parents ' discussion of their children's social skills and well-being. In terms of social transmission development, children can learn self-control from parents and other individuals. Hence, parents should be role models who transfer more self-control to their children. In terms of self-regulated development, parents can encourage their children to rethink their behaviors, which, in turn, provides children with the opportunity to respond and modify their behaviors by themselves. This process can develop children's learning of social skills and wellbeing. Therefore, the tension of parents 'perception of their children's self-control and engagement in activities that make them happy and motivated to persevere influences children's development because children are able to modify their behaviors when they feel conflict during the social learning process (Ginsburg & Opper, 1988).

Conclusion

Parents 'perception of, and involvement in their children's math learning can impact their children's overall experiences. In this study, parents recognized that, although they expected their children to perform well in school, they were mostly interested in their children learning problem-solving and social skills and having a good, healthy, and moral character. The program's activities relied on children and parents engaging in teamwork, creative thinking, and problem-solving. This study calls attention to parents and educators concerning students 'individual mathematics learning experience. Future research is needed to explore the after-school program, how to build partnerships among parents, and the ways in which school might let students experiencing more mathematics learning through integrating arts.

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