

CHILDREN AND THEIR PARENTS: LEARNING MATH TOGETHER AND HAVING FUN

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Abstract

The Esso Family Math Project is a community-based program designed to provide parents with strategies to facilitate their children's mathematics development. During the evening sessions, parents and children enjoy math activities together under the guidance of trained leaders. The goal is for families to have fun participating in activities that reinforce math skills and promote the understanding of mathematical concepts.

Research from the past twenty years has provided ample evidence that it is imperative for parents to be involved in their children's education (Chavkin, 1993; Epstein, 1994; Ford, Follman & Litz, 1998; Henderson, 1988; Onslow, 1992; Sattes, 1985). A recent international study of 32 countries by the Organization for Economic Cooperation and Development (OECD), confirmed the results of this earlier research, finding that parents who talk with their children and provide environments that stimulate thinking, are likely to positively influence the outcome of their children's education in reading, mathematics and science (OECD, 2000). While some families already engage in the types of activities advocated in the report, there are many parents who are unaware of strategies that help facilitate children's mathematics development.

Lack of involvement on the part of parents is generally not due to a lack of interest. Parents want their children to be successful and develop a love of learning, but when it comes to mathematics (a subject many parents do not

enjoy or understand themselves) they are often at a loss as to how to provide the necessary learning experiences. Not only are topics like probability, statistics and patterning new for countless parents, the way mathematics is now taught is also unclear to many of them. If parents are going to be partners of the learning process with their children's teachers, then they need to understand the new content of the school curriculum as well as the teaching strategies that are most effective in facilitating children's understanding of this important but abstract topic.

In East Asian countries, effort is considered to be the primary factor in determining whether a person will be successful in mathematics, whereas in North America ability is regarded as being the principal determinant (Romberg, 1992; Holloway, 1988; Stevenson, Lee & Stigler, 1986). Although many parents consider mathematics to be important and difficult, they also think it is dull, boring, and based on the

memorization of rules and procedures (Brown et al, 1988). Parents need to recognize that although understanding mathematics is difficult, it can be achieved, with effort and enjoyment, through participation in appropriate activities.

McLeod (1992) has asserted that improvements in mathematics education will only occur once the affective responses of both children and adults have changed. Research has clearly indicated that

children's attitudes towards mathematics are strongly influenced by the attitudes of their parents (Parsons, Adler & Kaczala, 1982; Pederson, Elmore & Bleyer, 1986; Stigler & Perry, 1988). There have also been numerous studies indicating a positive correlation between

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attitude and achievement in mathematics (Dossey et al. 1988). Hence, if educators are to enhance the positive attitudes of children and reduce their negative feelings, it would seem beneficial to spend time working with parents, increasing their knowledge about the teaching and learning of mathematics.

Basic skills are important, but parents must realize that it is a disservice for children to complete twelve years of schooling to be little better at mathematics than a \$5 calculator. While parents need to engage in activities with their children that advance the learning of basic skills, they must be aware that this effort alone will not guarantee success in high school math courses. Students fail at this level because they do not understand the structures of arithmetic, and consequently, fail to understand generalized arithmetic (basic algebra). This lack of understanding explains why the use of calculators on high school tests does not lead to greater achievement

This article will discuss a program (The Esso Family Math Project¹) that appears to be constructive in increasing parents' confidence in, attitude towards, and understanding of, a subject that many parents disliked and failed to grasp during their own schooling. For the past two and a half years, members of the Esso Family Math Centre², at the Faculty of Education, University of Western Ontario, have been creating and developing mathematics resources that are carefully designed to facilitate mathematics advancement through the use of readily available materials and everyday situations. Staff from the Centre train volunteers to use these resources in community settings with parents and their children. The goal is for families to have fun participating in activities that reinforce math skills and promote the understanding of mathematical concepts. This notion of involving families in their children's mathematics education is not a new one. Family Math

originated at the University of California, Berkeley, in the early 1980s and has spread worldwide. There are still many parents, however, including those most in need of help, who could benefit from such a program. The mandate of the Esso Family Math Centre is to help these parents.

Bringing Family Math into the Community

The Esso Family Math Centre offers its program to interested community organizations, especially those that work closely with families who are in need of external support. At each site, community representatives work with the Esso Family Math staff and, over a three-year period, gradually take on increased responsibility for the program. The goal is for communities to adapt the Family Math activities to meet the unique needs of their families and, in doing so, take ownership of the program, continuing it beyond the three years of involvement in the Esso Project.

A viable Family Math group consists of approximately ten families. A family unit has an average of three members e.g., two parents and a child, or one parent and two children, and thirty is a large enough group to manage. For each group, it is desirable to have one experienced teacher leader and four or five volunteer facilitators. This ratio provides one facilitator for every two families. The teacher leader guides the program at each site, but the volunteer facilitators usually take turns introducing new activities, thereby increasing the pool of knowledgeable leaders for future years. Ten hours of training is provided for everyone working in an instructional capacity at an Esso Family Math site. The training assists volunteers in understanding both the mathematics and the philosophy associated with Family Math. It is also crucial that all volunteers develop the skills necessary for working effectively with parents.

¹ The Esso family Math Project has two programs – one for families who have children in Junior Kindergarten, Senior Kindergarten and Gradel, and one for families who have children in Grades 2-5. The content of the two programs is different, but the teaching strategies are similar. The strategies discussed in this article were found to be worthwhile in both programs.

² The Esso Family Math Centre is supported by the Imperial Oil Charitable Foundation, and the Maurice Price Foundation. The Centre also has productive partnerships with Investing in Children (London), Texas Instruments, and the London Urban Services Organization.

The Importance of Community Building

Even more important than the materials used to better prepare parents for assisting their children's mathematical growth, is the environment that is established by Family Math facilitators in the community settings. It is essential for parents and their children to feel that they are in a safe and relaxed environment; a place where they can make errors, learn from these errors, make sense of the mathematics they are learning, and grow as a family by having fun and gaining knowledge together. Building a community is a crucial part of the Esso Family Math Project. A project objective is to help parents and their children gain confidence during their participation in the sessions and to ask questions when they do not understand.

Having dinner together at the beginning of each evening facilitates this community building. An initial concern of the Family Math staff was keeping families with young children too late in the evening. Many parents work outside the home, therefore it is difficult for them to get home, cook dinner, and be at Family Math by 6:00 pm. This problem is overcome by having an inexpensive, but nutritious meal (approximately \$3.00 - \$4.00 per person), at 5:30 pm. Since the sessions are offered in community centres, meals can sometimes be prepared on site by volunteers.

A serendipitous result of having these dinners together is the community building that has emerged. Parents, children, and Family Math facilitators eat together and chat with one another in an informal setting prior to starting the Family Math activities. There is always an introductory math activity (usually involving estimation or math related literature) for parents and children to participate in on their arrival at the site, as well as a discussion regarding home challenges from the previous week. While math talk is initiated by these activities, the discussions are often non-mathematical with parents and children discussing their social and personal lives with the Family Math facilitators. It is these discussions that have enabled the community building to occur over a short span of time. As well, the

informal discussions have allowed parents to feel relaxed and confident enough to ask questions about mathematics before, during and after Family Math sessions.

Respecting the Uniqueness of Each Family

Children and parents from different socio-cultural and socio-economic backgrounds come to Family Math with varied mathematical skills and understanding. It is important for all Family Math facilitators to value what participants know, and respect the contributions they bring to the sessions. Building on prior knowledge is the key to meaningful understanding. Children's, and parents' understanding of mathematics improves when they are able to make connections (which are sensible to them) between school mathematics and real world mathematics (Onslow, 1991). Topics that make these connections permeate the Esso Family Math programs.

There are vast inconsistencies in the development of young children – cognitively, linguistically, physically and emotionally. All of these aspects play significant roles in children's mathematical development, and must be considered when planning for unique Family Math sites. Effective Family Math programs must mesh with the developmental levels of the children, and Family Math facilitators need to help parents understand the mathematical experiences that are appropriate for their children's growth.

The Importance of Developing Good Parenting Skills

Helping parents expand their parenting skills is an important component of the Esso Family Math Project. It is essential that Family Math facilitators model positive parenting skills, demonstrating worthwhile strategies to help parents relate to their children. Facilitators model these skills without acting in a prescriptive manner, or appearing to be judgmental of a parent's present behaviour. Perhaps the best form of modeling is doing the Family Math activities with the families. Parents must learn how to invite their children to share their

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thinking, encouraging them to communicate their understanding (or lack of it) in a secure and stress-free environment. It is valuable for everyone to appreciate the significance of *not knowing*, and use these occasions as opportunities for growth rather than anxiety. Becoming a good listener is hard, and takes time and patience. Parents often need to practice waiting for their child to think through a problem. As well, they should not be critical of an incorrect answer, or excessive in their praise of a correct one. Incorrect answers, however, need to be corrected in a positive fashion. When a family enjoys learning a challenging topic together, while respecting each other's thought processes, everyone benefits.

Children develop a love for reading when parents read to them on a regular basis. A love for mathematics develops in a similar fashion. Parents can help their children appreciate the patterns and relationships in mathematics by playing card games to practice basic numerical skills; sorting laundry, cutlery or groceries to develop classification criteria; and, finding and discussing the multiplicity of mathematical experiences occurring in the daily world in which their children live.

Parents' Responses

Once parents understand how and why mathematics is presently being taught in our schools, they begin to make sense of it for themselves (often for the first time), and generally become enthusiastic partners in the education of their children. Members of the Family Math Centre attempt to assist parents' understanding and appreciation of why games and manipulatives, rather than the worksheets so many of them remember as *real math*, are being used to help their children's understanding of mathematics. Parents also have to become

convinced that talking with (rather than to) their children is important. They need to understand why listening to their children will often tell

them a great deal about their children's knowledge of mathematics.

One mother, Joan², had little confidence in her mathematical ability and attended the sessions so as to better understand

the mathematics presently being taught in school, and to be able to help her son with homework. She perceived that she was "dumb" [her words] when it came to mathematics. During the course of the Family Math sessions, however, the mathematics that she had learned previously by rote began to have meaning, and there was a desire to learn more. As she remarked after week four, "I now know why I am getting my answers. It's great." Lawler (1981) has reported on the positive reaction, or "*aha!*" happening that occurs when a child first recognizes a connection between two related mathematical ideas. It is equally important for parents to experience such insights based on rational thought rather than arbitrary rules.

Many parents are initially unmotivated and hesitant about coming to Family Math for six evenings, of approximately two hours each, to do mathematics. As one parent remarked, "I could not think of fewer ways I'd like to spend my time, but Mia [her daughter] wanted me to come." After the second night, this same parent remarked how the time had "flown by" and that she was thoroughly enjoying the experience with her child. Consequently, Family Math is offered for three sessions (once per week), and on the second session it is announced that a further three weeks of Family Math is available if that is what the parents would like. There has only been one case, over the last two and one half years, when a group has not opted for the extra three weeks.

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² All names are pseudonyms.

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Where's the Math?

Many parents remember math as the tedious task of completing large numbers of worksheets, with answers that were right or wrong. Naturally, they often cannot understand the mathematical value of playing a game, going on a math walk, using manipulatives, exploring patterns on a calculator, reading a math-related story, or singing a math-related song to their child. It is the responsibility of Family Math leaders to reveal the mathematics to the parents, and only use games and activities that improve a child's mathematical skill and understanding.

Empowering parents not only motivates them to learn more, it can change their attitudes towards teachers who have students *playing* in the classroom. In Family Math sessions, parents have opportunities to see how complex symbolic mathematics can be when adequate representations are not available, but how logical and understandable a concept becomes when suitable models are provided. Strategies used in today's classrooms begin to make sense once parents have opportunities to be actively involved in the process of *doing* mathematics.

Francine provides a vivid example of this phenomenon. She was displeased with the school system and, in particular, with the manner by which her child was presently learning mathematics. Francine believed that her child had wasted her grade two year in mathematics playing with materials, and was about to now fritter away her time in grade three. She had complained to both the classroom teacher and principal, but had never been satisfied with their explanations as to why manipulatives were used in math. Francine's daughter had stopped asking her questions related to mathematics and seldom discussed what happened in school. A rift had developed between mother and daughter. After attending the Family Math evenings, Francine stated that she realized how little math she had understood in school, and how the games and activities helped her to make sense of various concepts. "I thought these math centres were

just playtime, that the children weren't actually working at math. It was more like, let's have fun and forget math...but I was wrong! After I went to Family Math, I realized that the games helped me understand. I even went home and told my husband. I want other parents to realize this because if I hadn't gone I'm sure to this day I would have believed that the way they now teach was wrong." After the Family Math sessions were completed, Francine, her husband and their daughter continued to play math related games at home, discussed activities completed at school, and enjoyed their math time together.

For each evening's activities, the *Esso Family Math Resource Guide** has a section titled *Where's the Math?* The mathematical benefits gained from playing each game, doing each activity, or reading each story, is explained, and the teacher leader and volunteers can use this information when talking to the parents during activities to encourage *math talk*, reflection and communication. During the last ten minutes of an evening, the teacher and community leader review the evening's mathematics with the parents, introducing the math language that is typically used in today's classrooms, encouraging questions and promoting discussion. At this time, the other Family Math facilitators review the *Home Challenges*, replay a game, read a math-related story, or enjoy a snack with the children. Parents are also reminded that practice at home during the week (replaying some of the activities featured during the Family Math session, and completing the *Home Challenges* provided each week) are an important component for improving their children's skills and understanding, and developing a positive attitude towards math. Some weeks parents and/or children are asked to complete a questionnaire to inform the Esso Family Math staff of the activities they enjoyed, found challenging, or were difficult to understand. The feedback is used to improve the program.

To provide a link between the Family Math activities and the Ontario Mathematics

* The two Esso Family Math Resource Guides can be downloaded, free of charge, at the Esso Family Math web site (<http://www.edu.ewo.ca/essofamilymath>)

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Curriculum, the *Resource Guide* usually lists two expectations from the Ontario Ministry's list of overall/specific expectations. One expectation is taken from the youngest applicable grade level of the program, and the other is from the oldest applicable grade level. This information is included for teacher leaders so that they can demonstrate to parents how the Family Math activities are part of, and not just supplemental to, their children's school program. Once parents understand the benefits of what they are doing, they usually become supporters of the program rather than antagonistic towards what many previously thought of as *play*. The program provides examples that illustrate how productive play assists understanding — for parents as well as their children. Some of these activities are discussed below.

Math Walks

During one of the Family Math sessions, families go on a geometry walk (either inside or outside, depending on the weather) that illustrates ways in which parents can take advantage of the environment in helping their children see mathematics in the real world. Recognizing mathematics in their surroundings is crucial for math to make sense to children, and be more than abstract symbolism. The teacher leader explains how, in the real world, they will not usually see perfect spheres or cones, and finding close replicas is fine. When the families have completed the walk, what they have seen is discussed, together with objects found by most of the families and those seen by very few.

Concrete examples such as a sugar cube, an ice cream cone, a triangular prism used as the container for the Toblerone bar, and a cylinder for a can of juice, help children learn the language of geometry. For the Home Challenge that week families are asked to take a geometry walk around their house. The following week they discuss all the 3D objects they found.

Once parents become comfortable with an activity such as this one, similar experiences can occur on a trip in the car or in a bus, walking their child to or from school, playing in the park,

or shopping at the grocery store. Math walks can include looking for patterns, numbers or shapes, and are limited only by one's imagination.

Literature and Music

An important component of the Esso Family Math Project is the *Literature Connections*. Literature is featured frequently in the Early Years program, and included in each night of the Grade 2-5 program is the reading of one math-related story. Building a good relationship with the local library is vital since sometimes the teacher leader reads only part of a book and then asks the parents to finish it with their children at the public library. As you have no doubt guessed, there is a hidden agenda! Establishing excellent relationships with local librarians provides additional support for the program. In the past, librarians have purchased copies of the books used by Family Math (if they were not already available) and even attended sessions, reading to families and explaining the extensive number of library materials available, free of charge. Currently, two public libraries are establishing Family Math programs on site.

Music is also a part of the Early Years program. A group of music students and their professor at the Faculty of Education at Western, worked with the writers of the Early Years material to produce a CD and cassette tape. They used public domain music (so that families would know many of the tunes, and royalty payments could be avoided) and rewrote the lyrics to include early math concepts. The songs (and actions that often accompany the songs) are a part of the Early Years program, and families are given a CD or tape to use at home. There has been an excellent response from parents who have reported that their children enjoy the songs and quickly learn the lyrics. It is also great fun to see Dad do the *Hokey-Pokey* with his young daughter as she learns the concept of inside, outside, and round about (See Figure 1).

Games and Activities

Parents can help their children see the patterns and relationships in mathematics by: playing card

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Figure 1

String Activity

Materials
Piece of string per family approximately 3 metres long

Instructions
Leader asks family to put string in the shape of a square or triangle.

- Family follows leader's directions:
 - Go around your shape.
 - Jump inside your shape.
 - Wiggle inside your shape.
 - Jump outside your shape.
 - Tiptoe forward around your shape.
 - Move backwards around your shape.
 - Etc.
- Change the shape of the string.
- Have parent (mom or dad) give directions.
- It is at this point where developmental understanding will vary with each child. These differences must be respected.
- Change the shape of the string.
- Now have the child give directions to the parent. The ability to communicate is a crucial part of a child's mathematical development.

Song: Hokey Pokey

Materials

- Family Math CD
- CD player

Instructions

- Families use string from "The String Activity".
- While the leader plays the selection Hokey Pokey from the CD, the families follow the directions from the song while standing around their string shape.

Where's the Math?

Where's the math in this figure pertains to both the activity and song.

This is an active representation of such spatial relationships as:

around on beside
inside outside through, etc.

It engages the family in happy, productive early geometric activity. Spatial relationships are the basis of early geometric understanding.

Learning expectation - use language accurately to describe basic spatial relationships

Grade One C expectation - explore and identify two-dimensional shapes using concrete materials and drawings (e.g., circle, rectangle, triangle)

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games to practice basic skills; finding and discussing mathematics in numbers around the home; posing simple math challenges; and, talking about math in the daily world in which the child lives. Whenever possible, materials for Family Math games and activities are ones that are available in most homes. For example, money is used to play the game *Race for a Loonie*, which helps children understand the concepts of place value, trading, and the regrouping process associated with addition. The more difficult concepts of trading and regrouping in subtraction are developed through the game *Spend a Loonie* (See Figure 2).

Multicultural games and activities are used in the Grade 2-5 program to provide a context that makes mathematics significant and meaningful for all Canadians. First Nations' games such as *Deer Buttons* and *Awitlaktannai* help children understand the early ideas of probability and problem solving, thus demonstrating that mathematics is evident in all cultures. The African game of *Mancala* has proved to be well liked, as is the ever popular Chinese *Tangram* puzzle. Finding a *hook* is often all that is

Figure 2

Race for a *Loonie

Materials

- Game boards
- Two dice
- Pennies
- Dimes
- Loonies
- Container for the "bank"

Instructions:

- Use a game board for each player. Give each player 10 pennies, 10 dimes and 1 loonie to act as "the bank" during the game.
- The first player rolls the dice and adds the numbers together. That sum is the number of cents the player receives from the bank. The player places them in the "Cents" column of their game board. Whenever there are 10 pennies in the "Cents" column, the player should exchange them for a dime from the bank. Likewise 10 dimes are exchanged for a loonie.
- The first player to get a loonie is the winner.

Spend the Loonie

(A more difficult game of subtraction)

Instructions:
This game is the reverse of "Race for a Loonie".

- Players start with a loonie and try to get rid of it.
- Players roll two dice, add the numbers together and put that many cents into the "bank".
- The first player to "spend" all their money is the winner.
- The most difficult roll is the first one. The player will need to exchange the loonie for 10 dimes. Then they will exchange one of the dimes for 10 pennies.

N.B. Consider the difficulty of $100 - 6$. It is the regrouping which causes problems for so many children. Once they know how to regroup (and why) subtraction is mastered quite quickly.

"Loonie" is the term applied to the Canadian one dollar coin.

LOONIE	DIMES	PENNIES

Where's the Math

Our number system is based on groups of ten. This activity has the children trading every time they get, or need, a group of ten. It also links math to real world money. The first game, "Race for a Loonie", is linked to the idea of "trading", whereas the second game, "Spend a Loonie" will assist children with the notion of "trading" in subtraction.

CC 1b1 - identify place-value patterns (e.g., trading 10 ones for 1 ten) and use zero as a place holder

CC 1b2 - make numbers grouped in 100's, 10's, and 1's and use zero as a place holder

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required to get parents and their children involved in mathematics. It is also rewarding to see persistence, so essential for mathematical problem solving, developed and practiced through the playing of these games.

Family Math Certificates

As a way of saying, "Congratulations!" to all families and, "Thank you!" to all facilitators, the Family Math program ends with a celebration in which all participants are presented with a Family Math Certificate. After obtaining permission, digital photographs of all participants and facilitators are taken and then merged onto the certificates (See Figure 3). It is hoped that this lasting memory of Family Math will encourage families and volunteers to continue their involvement in mathematics.

Closing Remarks

Observations of the Family Math evenings indicate that parents and their children become less anxious once they are comfortable

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Figure 3



experimenting with new ideas and they realize that they do not have to know the correct answer or rule immediately – that guessing and checking is a legitimate aspect of mathematics. During the initial evening, parents,

and to some extent children, are often hesitant about attempting new activities or playing games not previously encountered. Toward the end of the sessions, however, parents and children confidently play new games, and engage in more risk taking. At the same time, many parents

have commented that understanding the why of math has made learning more meaningful and enjoyable for them. As Misha explained, "I liked the hands-on approach to math as it gave concrete reasons to things I had just done because *that's the way it's done.*"

Figure 4



Family Math encourages the building of a supportive atmosphere where enthusiasm for

learning is fostered, anxiety is reduced and curiosity is promoted (See Figure 4). Children, whose confidence in their mathematics is low, need help developing their self-esteem. Such assistance is unlikely to come from parents whose self-concept in mathematics is also low. These parents are far more likely to hold the negative images of mathematics they remember from their school days. Parents may also conjure up negative images of manipulatives if they consider them to be time wasting and unproductive. Once parents understand the rationale for linking symbolic ideas to concrete representations, however, they are likely to appreciate the strategies being used in today's classrooms.

Children, whose confidence in their mathematics is low, need help developing their self-esteem. Such assistance is unlikely to come from parents whose self-concept in mathematics is also low.

For children to gain the most from our education system, parents need opportunities to recognize why teachers do what they do, and parents also need to develop some of the skills that will assist their children's learning at home. Family Math emphasizes that parental

support will ultimately benefit children's attitudes, self-esteem, and potential to understand mathematics. By providing venues for actively sharing with parents the strategies and resources that they can use at home for assisting their children's learning, this program illustrates that all parents can help their children experience success in mathematics.

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