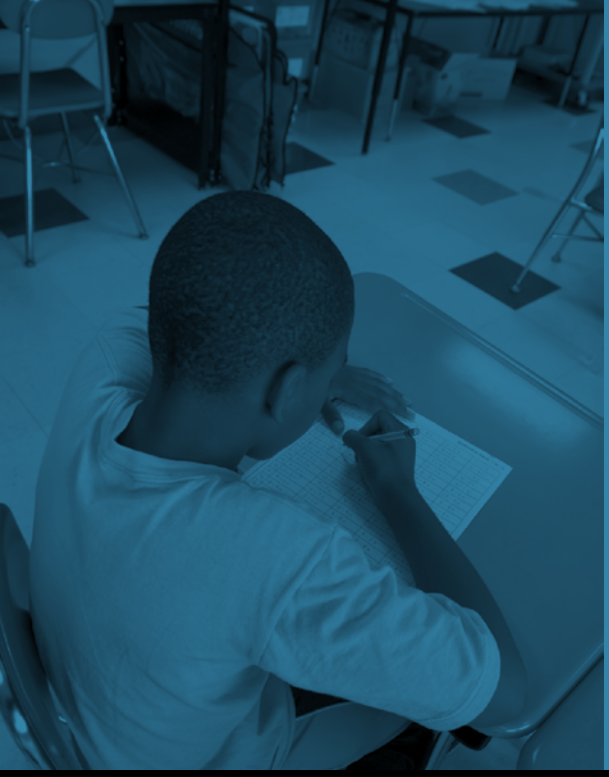

MATHEMATICALLY TALENTED CHILDREN: HOW CAN PARENTS HELP?

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"My son used to love math. Now, I see him struggling and bored."

"My daughter is so turned off from math in school that I need to do something with her at home. But, I don't know what."

"I have always been very involved in my child's education. But, his math is now going far beyond what I know. It is now out of my league. I don't know what to do."

"I don't know how to get the school system to challenge my daughter in mathematics. I don't want her to lose the edge she has."

These and many other comments come from parents throughout our nation. In this article, we will provide some recommendations for parents who want to facilitate the continuing mathematical development of their mathematically talented child. The objective of assisting parents is central to the text, not mathematics *per se*. As authors and professional educators, we are also parents who want to support other parents who are looking for ways to positively enhance their child's mathematical learning and experiences. This article considers various aspects that affect mathematically talented students and may have a positive or negative impact on their continuing pursuits to learn more mathematics.

Five Foundational Issues

Before we provide recommendations regarding how parents can help their mathematically talented child, it is important for parents to understand a few philosophical beliefs we hold. First, your child deserves all the help he needs, including additional resources, experiences, and opportunities, to continue his pursuit of advanced mathematics. Every child should get what she needs to reach her potential. We cannot measure one child by the rule of the majority or by an equal distribution of resources. Rather, we believe that the educational system should provide *all* children with everything that they need to progress as far as they can. Nothing less will do, even for children who are truly gifted and advanced beyond their peers. We are not encouraging parents, whether through school or home, to provide their child *more* than all other children get, but rather that they provide experiences that are consistent with, and appropriate for, the needs of *their* child.

Second, it is very important for parents to honestly and objectively assess the mathematical level of their child. Despite best wishes, not every child is an Einstein, nor is every child average. Parents must work with educational and psychological experts using numerous assessment strategies and examinations to clearly understand both the ability and the learning style preferences of their child in order to best ascertain how to help the child progress even further. For the purposes of this article, we will not quibble over vocabulary. All too often, the terms *gifted*, *advanced,* and *talented* are politically heated and carry agendas that do not necessarily relate to a child's ability. This article will use the singular term *mathematically talented* to denote a student whose abilities are above the norm. We will refrain from differentiating how much or little above the norm is a mathematically talented student. It is up to parents, together with the child, the teacher, and the school sys-

tem, to first determine if the child is talented before making educational decisions for the child.

Notably, however, many means beyond scholastic assessments are available to lead to an intuitive belief that a child is mathematically talented. Many parents recognize in their child unusual mathematical talent, precociousness, or an unusual level of interest in mathematics at a young age. Some notice that mathematical skills and understandings usually associated with significantly older children are evidenced in their child. Parents should understand the mathematical development of their child before attempting to significantly alter his or her world.

Third, ability is not synonymous with interest. Not every child wishes to continue to pursue his study of mathematics beyond that offered in the regular classroom. You must know your child and determine with her input whether she wishes to continue in her studies of mathematics. Although your child may be mathematically gifted, if he is disinterested, too much parental encouragement may be interpreted as additional and unwanted pressure. Thus, some students who lack interest in mathematics may still be very advanced in the subject. Just because mathematics may be easy does not mean a child is interested in the topic.

Fourth, one size does not fit all. Not every parent is competent to personally assist a child with the study of advanced mathematics. Parents should not place undo pressure and guilt on themselves. Rather, they should consider these recommendations and find those that best meet the needs of their child and the family as a whole. Every child and every home is different. Parents must be cognizant of the many dynamics within their own home and make the best choices accordingly.

Fifth, many cultural dynamics affect mathematically advanced children. Parents must be aware of pressure that will be placed on the child to conform to lower standards by peers, culture, and even the school system. Additional factors inhibit girls from pursuing advanced mathematics. Thus, parents must become advocates for, and allies with, their child in pursuing mathematical experiences that will allow her to reaching her fullest potential in mathematics. Additionally, parents must recognize the burden that meeting the needs of a mathematically talented child may impose on the family. As with a star athlete who may need coaching, special training, and numerous experiences far beyond the needs of average students in order to meet their advanced potential, the needs of a mathematically talented student also may impact the time and resources of a family. Parents, and indeed the entire family, must be willing to sacrifice to meet the needs of such a child.

With these preliminary considerations in place, we now provide parents with recommendations for furthering their child's mathematical pursuits. These recommendations will be differentiated by whether or not they primarily occur in respect to the school system or extracurricular experiences. We begin by considering parental involvement with the child's school system.

Navigating the School System

Parents are not always fully aware of the numerous activities available to their mathematically gifted child through some public schools. In an effort to both attract and support these students, some schools have implemented excellent instructional programs and competitions for mathematically talents students. It is incumbent upon parents to investigate their local schools to ascertain what is offered. Some schools will have in place resources, teachers, and experiences that fit well for the mathematically talented child. These may include honors courses, gifted and talented clubs and course work, and association with mathematical competitions. We encourage parents to speak with school personnel and find the best placement for their child. When systems already exist, parents will typically find that schools are willing to accept students into these activities to maintain adequate enrollments so they may continue to offer such experiences.

If, on the other hand, parents find that their local public schools do not provide adequate programs for mathematically talented students, parents must be simultaneously firm and sensitive toward schools, administrations, and teachers in order to procure additional assistance and resources for the mathematically talented student. Parents must strenuously advocate for their child's mathematical development while being sensitive to the constraints under which schools, administrators, and teachers exist. Whereas parents must sympathize when the entire school system is overextended, they must also passionately seek the resources and experiences that their child both needs and deserves in order to reach her mathematical potential. Parents may be forced to walk an emotional tightrope with the school system.

Some schools simply do not provide adequate instructional resources for mathematically talented students. Occasionally, inadequate programming is due to a school or admin-

istrator taking the position that advanced children are already blessed and all additional resources should be expended on the masses of students who need greater assistance. More often, failure to provide additional resources to advanced students is simply a result of severely limited resources that require school personnel to make difficult choices regarding school programs and program delivery. Teachers are already stretched to their limit with multiple classes, large class sizes, inclusion of special needs students, documentation requirements, and endless meetings. Parents must simultaneously be intolerant of schools that refuse to provide services for advanced students for misguided philosophical reasons and sensitive to schools that are attempting to do their very best with paltry resources at hand. To this latter scenario, we offer the following recommendations.

• *Form a team*. Parents should get to know their child's school well. They should investigate what resources exist and which teachers support the more mathematically talented students. Parents should ensure that the relationship between them and the school is polite, respectful, and never adversarial. If parents and school personnel can form a team in support of the child, success will be more assured.

• *Communicate with your child*. In seeking additional resources for their child, parents should understand the sometimes cryptic complaints of their child. "I'm bored," hardly adequately explicates the needs of the student. Is he bored because he doesn't like the subject matter, the delivery methods, the pacing, or the low level of the content? Parents must communicate effectively with their child in order to best ascertain what she needs from the school. Advanced students are usually more able to communicate with their parents and schools and participate in the decision-making regarding their academic future. Parents should ask their child if she believes that there is too much repetition and practice of basic skills. Does the teacher provide too much time to complete a task? Are students allowed to read or work on other tasks while waiting for other students to finish an assignment? Understanding the child's perspective on the events of the school day may provide parents and school administrators with better insight into the needs of the child.

• *Create positive accommodations*. Through their attempts to provide mathematically talented students with more challenging and enriching learning experiences, some schools may implement one or more objectionable practices against which parents must guard. First, many teachers simply pile extra work on talented students. Although no malice may be intended, the workload can easily be overwhelming. So, in an attempt to make positive accommodations for talented students, some schools bury the desire to excel under a mountain of meaningless and time-consuming homework. Second, well-meaning teachers often use mathematically talented students as free teacher aides and tutors for other students. Although some may argue that learning is accentuated when one has the opportunity to teach, this practice removes from the mathematically talented child the opportunity to encounter and learn additional mathematics commensurate with his or her abilities. They may be learning the old mathematics more fully, but they are

not having the opportunity to see new materials and gain new knowledge.

Various methods of accommodations and advancement are available for students who are academically advanced. Through careful consideration and negotiation with the school, the parent may negotiate some strategies to provide their child with what he needs. Some of the strategies to provide the student with involvement with more advanced mathematics include: early admission to Kindergarten, middle school, high school, or college; placement into more advanced classes or grades, by individual subject or *in toto*; grade skipping; compacting material within a grade level; continuous progress or self-paced instruction; and mentoring and extracurricular programs. Each of these strategies carries its inherent strengths and weaknesses. Parents, together with the child, the teachers, and the administrators must determine what is best for the student.

Teachers have much control over what is taught in their class and what instructional practices they use in their classes. Teachers can significantly affect the mathematics that students encounter by making alterations in the pace, breadth, and depth of the mathematics instruction. Each of these factors can revolutionize a student's experience and reinvigorate her pursuit of mathematics. Other techniques that are less dramatic include teachers selecting more appropriate sets of homework problems for mathematically talented students and teachers focusing on providing students with various experiences in reading, analyzing, synthesizing, and evaluating mathematical books and passages.

Classroom teachers should focus on developing within all students, and certainly within mathematically talented students, deep conceptual understanding of mathematics rather than mechanistic procedural knowledge. To this end, teachers can lead students to continually ask why certain mathematical concepts or procedures hold, investigate mathematical theorems and definitions, develop alternate mathematical systems, and raise their own mathematical questions. It is important for teachers to lead these students to look more deeply into common mathematics seen in regular classrooms. This can be accomplished by connecting instruction and investigations to the recommendations provided in the *Principles and Standards for School Mathematics* (NCTM, 2000). This volume of mathematics education reform recommendations defines its principles as:

> *Equity*. Excellence in mathematics education requires equity—high expectations and strong support for all students.
>
> *Curriculum*. A curriculum is more than a collection of activities: it must be coherent, focused on important mathematics, and well articulated across the grades.
>
> *Teaching*. Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.
>
> *Learning*. Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.
>
> *Assessment*. Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.
>
> *Technology*. Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning. (p. 16)

NCTM's text also distinguishes two types of standards and characterizes them as:

> The *Content Standards*—Number and Operations, Algebra, Geometry, Measurement, and Data Analysis and Probability—explicitly describe the content that students should learn.
>
> The *Process Standards*—Problem Solving, Reasoning and Proof, Communication, Connections, and Representation—highlight ways of acquiring and using content knowledge. (p. 30)

Although parents may need to have this list with them as they discuss various curricular options with teachers, mathematics teachers should already be well aware of NCTM's recommendations and how to apply them in their instruction.

• *Become aware of alternative experiences*. When parents find it impossible to procure the requisite resources and experiences that their mathematically talented child needs from their local public schools, other alternatives exist. Charter schools for students more interested and talented in the sciences and mathematics are continually coming into existence. More universities and high schools are providing students with opportunities to take classes via computers while off campus. These distance education models take many forms; some are via video conferencing, and others are provided over the Internet and through numerous types of interactive Web sites. Often, students are allowed to enter online courses that they would not be able to attend in a traditional face-to-

face style. Finally, and as a transition to providing mathematical experiences to advanced students through the home, many families have opted for either single family homeschooling or joining homeschool associations.

Providing Resources Through the Home

Many parents, for a number of reasons, are seeking assistance to help their mathematically talented child to continue her mathematical pursuits through arenas outside of the classroom. Today, countless opportunities are available to them, and generally, these will fall into three groups: community resources and mentors, encouraging children to discover mathematics on their own, and technological tools that are available to all.

Community Resources and Mentors

Community resources include the countless number of people in any community who are particularly skillful in mathematics. These may include mathematicians, scientists, engineers, accountants, professors, teachers, and others who use mathematics regularly. Parents are encouraged to find tutors and mentors who can help their mathematically talented child to continue his studies. Whereas tutors usually charge regular fees, mentors generally assist young people free of charge. However, far more than costs should factor into the parents' decisions regarding which option is best for their child. Tutors tend to look specifically at the mathematics that the student is investigating in their educational setting. So, a tutor will help a student with his mathematics work. A mentor, however, will show students the mathematics that the mentor encounters daily in his work. Thus, the materials covered may be very different. In fact, processes of tutoring and mentoring may differ significantly and proceed toward different ends. Although this brief article cannot fully explicate all of the distinctions with respect to tutors and mentors, it is nevertheless incumbent upon the parent to carefully weigh the merits of both and to participate fully in the selection of one or both for their child.

Selecting either a tutor or a mentor can prove to be daunting. Either must be chosen to complement both the child's temperament and the family's concerns. College students often make some of the most convenient and cost effective tutors. However, college student tutors may lack sufficient mathematical understanding, knowledge of the interconnectedness of mathematical topics, and skills with best instructional practices. Teachers and professors also work well, but are often quite busy and cannot devote the time needed by the child. Mentors are generally found from more academic, scientific, and business fields by networking within community groups and acquaintances. It is important for the student to understand that the mentor has expertise in certain mathematical fields and not in others. Thus, the mentor seeks to impart his or her knowledge to the student and does not seek to align that knowledge with any particular curriculum or course. Either the tutor or the mentor may work effectively for any student; however, all involved must understand the goals of the others.

Encouraging Children to Discover Mathematics on Their Own

Using Hobbies and Interests. Encouraging children to discover mathematics on their own can be fulfilling for both the child and the parents. Both parents and the child are often surprised to see all of the possibilities that surround them daily. Unfortunately, many parents all too quickly dismiss opportunities in which they find difficulty discovering the mathematical connections. For instance, video games are undeniably programmed with sophisticated "logical engines" in which users unconsciously use mathematics and logic to conquer the playing environment. Many other opportunities also abound and provide opportunities to encounter mathematics in stimulating ways. Every hobby or interest can be reinvestigated mathematically. From the arts (e.g., music, singing, dance, photography, painting, color, perspective, texture), to hobbies (e.g., model making, kite flying, cooking, collecting, crafts, puzzles, reading), to sports (e.g., individual and team, statistics, strategies), to socializing (e.g., communicating, cell phones, instant messaging), to technology, and so forth, all hobbies and interests can be mathematized. In so doing, the mathematically talented child can further his investigation of mathematics through a medium in which he is already interested. While this certainly enhances the interest level of the mathematical investigation, it also solidifies the notion that mathematics surrounds all that we do and is connected to interests outside of those seen in the traditional classroom.

Projects at Home. Projects around the home also provide rich opportunities for students to be involved in mathematics in real-world scenarios. As parents entertain the thoughts of creating a sun room, installing a swimming pool, creating new curtains for a room, painting the house, installing a lawn or garden irrigation system, buying a new car, or planning a family

reunion, the mathematically talented child can participate in the planning, designing, organizing, and purchasing of necessary components. These skills all employ mathematics. Bold parents may wish to have their child participate in the annual tax preparation and see how various expenditures and charitable giving affect various tax scenarios. Add to this a component of strategizing to minimize the next year's taxes, and the child can experience a robust mathematical investigation.

Investigations Outside the Home. Many investigatory opportunities also reside outside of the home. Parents and their children regularly see professionals who use mathematics in their occupations. Many of these professionals would be elated to speak with a promising child regarding various aspects of their careers. Architects, engineers, insurance agents, financial planners, optometrists, dentists, lawyers, accountants, farmers, business people, and countless others daily use mathematics and would be willing to share their knowledge with an interested child. Introducing a child to these opportunities again validates the idea that mathematics is used widely and applied in almost every field.

Puzzles and Games. It would be difficult for a person to have missed the new craze in this nation. The Sudoku rage can be witnessed in countless newspapers, on the Internet, and in bookstores. Adults and children alike enjoy the recreation of puzzles, challenges, and competitions. Because an inherent interest accompanies these activities, they make natural fodder for the continued investigation of mathematics. Parents should take the opportunity to investigate how to use natural recreations as a medium for their child to further her mathematical learning.

Books. Many children love to read. Today, an ever increasing body of literature is available to those who wish to meld mathematics with reading. For every level, books are being published that incorporate mathematics into the story line in intriguing ways. Whether mystery novels, crime drama, or cartoon stories for even younger children, bookstores and Web sites are filled with books and magazines that promote mathematics in a friendly, useful, and entertaining manner. This mathematically enhanced literature provides students with opportunities to experience mathematics and encourages them to continue in their endeavors.

Field Trips. Field trips to factories and businesses can prove valuable in allowing students to see the applications of mathematics around them. However, children are often especially interested in trips to mathematics and science museums. Although these museums do not exist in all cities, parents should plan to visit as they pass through metropolitan areas in which these museums do exist.

Other Learning Materials. Parents of the mathematically advanced child should search through used bookstores and yard sales for used mathematics textbooks and bring them to the home. These are usually very inexpensive and provide the child with countless mathematical examples and explanations. The child can then read and learn at his leisure. Most importantly, valuable resources will always be at his fingertips.

Technological Tools

Technology and Calculators. Although calculators are ubiquitous in mathematical learning today, many improvements have lead to mathematically sophisticated tools through which students can investigate mathematical concepts. Parents should ensure that their mathematically talented child has a graphing calculator as early as the middle grades. Although some educators argue that calculator use has become a crutch to many students and has hampered the mathematical development of many, this is rarely so for the advanced child who is more apt to use many of the features of the calculator as investigatory tools probing more deeply into mathematical concepts than as a replacement for reasoning and learning.

Independent Research. Often, the mathematically talented child seeks to continue her mathematical investigations independently. In these cases, parents should ensure that a rich variety of technology is available to the child. The Internet is replete with mathematical discussions and investigations. Parents should allow (albeit monitored) a child to dig deeply through various mathematical Web sites for materials. Numerous inexpensive computer software packages allow students to interactively investigate mathematical concepts (e.g., Geometer's Sketchpad, Fathom, Derive, TI Interactive). Parents should speak with school districts and teachers to see what software is being used in the schools. Those packages and others should also be available to the child at home. For families who cannot afford mathematical software, many Web sites provide learning activities for spreadsheet software packages (like Microsoft Excel and Corel Quatro Pro) that are included on almost all computers today.

Selected Resources

Parents are not always aware of the countless resources available to

them and their mathematically talented child. The short list in Table 1 provides some valuable Web-based resources that parents and students can access. Many of these resources refer to games, puzzles, books, activities, investigations, hobbies, competitions, ability testing, suggested scholastic accommodations, parent and student support groups, technology and calculators, and many other issues raised in this article in respect to mathematically talented children.

Conclusion

Parents of the mathematically talented child have many resources at their disposal. Ideally, parents should collaborate with their child's school personnel to evaluate their child's ability, needs, and interest in mathematics. Working with teachers and administrators, parents may help to craft a plan so that their child will be challenged in mathematics and allowed to learn at his or her own pace and level.

Schools cannot be expected to meet all children's mathematical needs if they are truly advanced and highly interested in math. Tutors and mentors, as well as enrichment and accelerative options, may need to be investigated. The child should be included in decisions regarding how much his mathematics program should be modified, because this will depend in part on his interest level and time commitments.

Parents can help their child to discover mathematics by enriching the home environment so that ordinary activities become opportunities to use mathematics. In one way or another, almost everything has a mathematical component, whether it is a hobby, a sport, the arts, technology, or even socializing. Projects and family trips provide all sorts of ways to utilize mathematics.

This article offers a brief glimpse of the myriad opportunities parents have for assisting their mathematically talented child to grow and continue to develop his or her mathematical interests and abilities. We hope that you will find our suggestions useful as you engage in the exciting world of raising a child with mathematical talent. GCT

Table 1
List of Mathematical and Gifted Education Resources

Ask Dr. Math http://www.mathforum.org/dr.math
Cool Math http://www.coolmath.com
Funbrain http://www.funbrain.com
Interactive Math Activities http://www.cut-the-knot.org/Curriculum
Math Forum Student Center http://www.mathforum.org/students
Math Games http://www.madras.fife.sch.uk/maths/activities.html
Mega-Math http://wwwc3.lanl.gov/mega-math
Set http://www.setgame.com
General Parent Resource http://www.hoagiesgifted.org/parents.htm
Success Stories in Gifted Education http://www.hoagiesgifted.org/success_stories.htm
"Is it a Cheetah?" by Stephanie S. Tolan http://www.stephanietolan.com/is_it_a_cheetah.htm

Reference

National Council of Teachers of Mathematics (NCTM). (2000). *Principles and standards for school mathematics.* Reston, VA: Author.