Probability and the New GPS
Ruminations on Being a Mathematics Teacher

by Dottie Whitlow
GCTM President

Have you ever reflected on your career as a math teacher? How did you become a math teacher? How would you describe yourself as a math teacher? How would your students describe you? Would their description fit with your vision of yourself as a math teacher? Think back to the events or decisions that led you to become a math teacher. Why did you become a math teacher? Did you always love math and want to be a math teacher? Did you find it while you were on some other path? Did it find you? What is your measure of success in being a mathematics teacher?

“…a child is to keep alive his inborn sense of wonder, he needs the companionship of at least one adult who can share it, rediscovering with him the joy, excitement and mystery of the world we live in.” —Rachel Carson

Maybe you became a math teacher because like Rachel Carson, you wanted to share the discovery and wonder that the world holds with young people. We all know the reward of seeing the joy of a student who has realized or learned something for the first time and takes pride in understanding it.

“Don’t limit your child to your own learning, for he was born for another time.” —Rabbinical saying

Maybe you became a math teacher because you were born for another time.

One of the most wonderful things to see, do and visit as we plan our time with our students is the joy of a student who has realized or learned something for the first time and takes pride in understanding it.

Regardless of your motivations and rewards, this can be tough work. Sometimes we have to wonder if we can get it all done: weave the dreams, make the progress, inspire the greatness, teach math to all. It helps to have a clear knowledge and focus on where we and our students are going. It is easier to do the work and walk the path when we know where we are going today, tomorrow and during our time together.

We do need to have a plan. There are many wonderful, worthwhile tasks and things to see, do and visit as we plan our time with our students. Hopefully you can plan, and you don’t suffer from the same troubles as E.B. White who says, “If the world were merely seductive, that would be easy. If it were merely challenging, that would be no problem. But I arise on the morning torn between a desire to improve or save the world and a desire to enjoy or savor the world. This makes it hard to plan the day.”

In your planning, I urge you to be deliberate, selective and focused about what you and your students do. Remember that mathematics in the world is interconnected and integrated; it doesn’t come in compartments, so neither should our teaching and learning. Try to figure out where your students are at the start of your time together; meet them there and begin the journey. Clearly communicate expectations to yourself and your students. That’s how we will know where we are...
CONT. FROM PAGE 1
going and whether we have arrived.
Do you want students to learn? Of
course you do. I suggest you start asking
them to talk and to think. Let them make
mistakes and fix them, both on paper and
in their thinking. Let them go home as
tired as you do because they have been ac-
tive learners each day. Sometimes we want
to help so much, we help them right out
of the learning by doing all the thinking
and answering for them. “The surest way to
make it hard for children is to make it easy
for them.” —Eleanor Roosevelt

Do you want students to enjoy math?
Of course you do. We can build con-
fidence and good attitudes by posing
problems and asking questions in ways
that help students express what they know
and allow all students to participate in the
mathematical dialogue at some level. Ask-
ing good, thoughtful questions, like “why”
and “how do you know” is the number
one strategy for raising student achieve-
ment. TIMSS helps us know that we are
not so good at asking good questions.
“It is better to know some of the questions than
all of the answers.” —James Thurber

We also build confidence in our students
by becoming learners right along with our
students rather than conveying that every-
thing has already been learned and discov-
ered, and it is their turn to memorize it.
We can learn with our students and learn
with our colleagues. This is important and
sometimes it can be scary. But we must
embrace it.
“To grow, a lobster must shed its old shell
umerous times. Each shedding renders the
creature totally defenseless until the new shell
forms... when risk becomes frightening, think
of the lobster, vulnerability is the price of
growth.” —Richard Armstrong

Talking and learning with our peers is
wonderful professional development. It
also isn’t always easy. We may disagree.
That’s okay, but we should try to under-
stand each other’s thinking. “When we all
think alike, no one is thinking.” —Walter
Lippman

Remember that Michelangelo was 81
years old when he is reported to have said,
“Still, I am learning.”
I hope that you can reflect on your
career and continually renew yourself. You
are the most important resource you bring
to any learning situation. I hope you will
ask yourself each day,

What messages did I send today?
Did I teach with excitement and
passion?
Did I communicate through word or
deed that I love teaching? That I love
math? That I love kids? That I expect great
and wonderful things?

I am proud of all of you, the mathemat-
ics teachers of Georgia! We can continu-
ually renew ourselves, our teaching, our
vision, our expectations, our students. Try
to remember,
Love and skill together can create a
miracle.

Dottie Whitlow

Did You Know?
by Becky King
Executive Director

The first Georgia Mathematics Confer-
ence was a one-day meeting on Saturday,
Feb. 15, 1958. The program for the day
consisted of an opening general session
followed by two sessions each for elemen-
tary and secondary teachers. During the
night of Feb. 14, Georgia had a near
record snowfall. One hundred and forty
people had made reservations for lunch,
but no money had been collected and
the GCTM treasury had only $18.75!
Despite the bad weather, 110 teachers
attended that day. Since that success-
ful beginning, money has been collected
with advance registrations. What a long
and wonderful history we have, and how
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Be a Volunteer at NCTM Atlanta 2007

We need many volunteers for the 2007 NCTM Annual Meeting and Exposition in Atlanta next March.

If you are interested, please take a few minutes to visit the online volunteer form at www.gctm.org/volunteer. Select the volunteer option that interests you and enter the days and times you are willing to serve. Starting in the fall, we will begin to assign volunteers to their responsibilities and you will receive more information. We would like volunteers to commit to serving for a 4-hour shift.

All volunteers will receive a special t-shirt and may register for the NCTM Annual Meeting and Exposition at the member rate. All college students who volunteer a minimum of 4 hours may attend any sessions on the same day they volunteer and they are not required to register. We do ask, however, that they never take the place of a registered paying attendee.

Thank you again for volunteering and we hope to see you in Atlanta next March. Please do not hesitate to contact one of us if you have any questions.

There is also a great opportunity to showcase Georgia’s students to thousands of teachers both nationally and internationally. During the 2007 Annual Conference in Atlanta, there will be an exhibit that displays exemplary student work. Your help is needed in collecting student work from all grade bands (P-16), as well as superb work of teacher candidates. Your assistance will help to highlight the excellent work Georgia students are producing. Some of the work may also provide examples for the Georgia Department of Education’s website in alignment with the Georgia Performance Standards.

If you are interested, please see the “Student Exhibit Application” and the “Student Work Permission Form” on our Web site www.gctm.org.

LAC Volunteer Committee Co-Chairs

Nathan Borchelt (nathanborchelt@clayton.edu)
Linda Nash (lindanash@clayton.edu)
Bryson Payne (bpayne@ngcsu.edu)
Soon it will be time to begin a new school year—new students, new curricula, new challenges and new opportunities! I am glad that GCTM is a part of these new beginnings for you.

From the membership report you can easily see that GCTM continues to grow. GCTM is its members. As a member I hope you take seriously your important role as a member recruiter and membership retention agent.

Right this very moment, won’t you please call a colleague who has never been a member and invite them to join us! It will help get their new year off to a great start!

What reasons can you give them for being a member of GCTM? Try these:

- Every teacher of mathematics should be a member of his or her professional organization.
- GCTM is the perfect choice for teachers of grade 8.
- GCTM offers awards and grants to GCTM members;
- GCTM will be hosting the NCTM Annual Meeting and Exposition in Atlanta in March 2007. Many local volunteers will be needed to make this the finest conference possible for teachers of mathematics from around the world;
- Every teacher of mathematics should be a member of his or her professional organization.
- GCTM is the perfect choice ...and that’s just the beginning of the list.

Please use the membership form in this issue to bring us one new member and Happy New School Year!

Each One Bring One

by Susan Craig
Membership Director

The third annual GCTM Academy was held at Thomson Middle School in Centerville, Georgia June 14-16. Teachers were enlightened with their choice of three workshops. Makoto Yoshida was the instructor for the elementary workshop for teachers of grades 3-5. Debbie Pass and Don Slater were the instructors for the middle school workshop for teachers of grade 9. Brad Findell was the instructor for the high school session. Comments from the participants indicate that the Academy was a great success.

“The 2006 GCTM Academy was excellent! The content and instruction techniques used will be very helpful in my classroom. The collaboration among the participants was also very insightful and useful.”

—Jane Tippins, Comer Elementary School, Madison County

“Dr. Yoshida was a fascinating instructor. His experience with both the Japanese and American education systems is unique. His approach to common mathematical concepts provided the elementary participants a fresh perspective. We were on the edge of our seats (and brains) for the entire 2 1/2 days.”

—Mary Matthews, Carver Elementary School, Dougherty County (Albany)

“This year’s GCTM Academy has been an exhilarating experience! I have been very skeptical about the ‘New’ GPS but these three days of actually taking part in activities and tasks that we will use to work with our students has been an eye opener. I have always tried to make math interesting for the students but I feel the new GPS is going to enhance their interest and mastery even more. Thanks GCTM.”

—Linda Rogers, Marion Middle School

Special recognition goes to Dan Funsch who fathered the idea of GCTM holding an Academy three years ago.

A big thank you goes out to Cathy Franklin for her energy and willingness to help in every possible capacity to assure that this year’s Academy went smoothly.

We are grateful to the Thomson Middle school staff for being so very hospitable.

Also, the generosity of our sponsors ETA and Texas Instruments is appreciated and the participants enjoyed some incredible door prizes.

“Wow! What a great summer workshop! It has provided me with a large number of activities to take back and actually be able to use in my classroom. There was never a dull moment! I can’t wait until next year’s institute.”

—Gayla Braziel, Sumter County Middle School

“The problem sets explored in this Academy showed me what is expected of our students with the roll out of the new standards. I look forward to next year’s Academy, not to mention the October Conference. I feel better about how this state is moving forward. I CAN DO THIS!”

—Amanda Avery, Cass High School, Bartow County (Cartersville)

“The summer academy was great. It caused me to reflect on my own pedagogy and I realized the things that I need to be mindful of in teaching. I also left with many ideas and activities that I can use with my students.”

—Alphonese Wilson, Westover High School, Dougherty County (Albany)

### MEMBERSHIP REPORT—JULY 2006

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Georgia Mathematics Conference at Rock Eagle, October 19 – 21

Come to the greatest state Mathematics Conference in the United States! We have exhibits by publishers and vendors, workshops by teachers from Georgia and elsewhere, nationally known speakers, exciting activities in the afternoons and evenings, and many opportunities to network with other educators. Other evening events will be the annual meeting of GCTM, installation of new officers, presentation of awards, and opportunities to win fantastic door prizes.

EVENING KEYNOTE SPEAKERS

Thursday evening:
Randy Charles
Steve Leinwand

Steve Leinwand is a Principal Research Scientist at AIR and is currently working on a range of projects involving K-12 mathematics, including Ohio K-8 diagnostic and achievement tests, a comparative analysis of Singapore Mathematics for the Department of Education as well as other projects. He served a 3-year term on the NCTM Board of Directors, during which time he helped review Principles and Standards for School Mathematics. Steve is also a senior author of Scott Foresman Addison Wesley’s K-8 mathematics program. He has written numerous articles and his new book, Sensible Mathematics: A Guide for School Leaders is published by Heinemann. Steve is a frequent speaker at state, regional and national conferences.

Friday evening:
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OTHER MAJOR SPEAKERS

Thursday:
*Phil Daro, Gail Englert, *Lou Matthews, David Fricke, Marilyn Stratchen
Friday:
Silvia Llmas-Flores, Ann Lawrence, *Doug Clements, *Asa Hilliard, Chris Franklin

* Biography included.

Asa Hilliard
Dr. Asa G. Hilliard, III is the Fuller E. Callaway Professor of Urban Education at Georgia State University, with joint appointments in the Department of Educational Policy Studies and the Department of Educational Psychology/Special Education. He has written more than two hundred research reports, articles and books on testing, ancient African History, teaching strategies, African culture, and child growth and development.

Phil Daro
Phil Daro currently works on advancing the design and use of leadership tools for improving mathematics instruction at every level of the educational system. He also directs the development of a middle school mathematics program inspired by the Japanese curriculum, and consults with states and school districts on their accountability systems and mathematics programs.

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Dr. Matthews has directed several innovative mathematics education programs and initiatives, which primarily focus on the empowerment of teachers and students of mathematics. He was elected in as the 2004-2006 Southeast Regional Representative for the Benjamin Banneker Association, Inc., a national affiliate of the National Council of Teachers of Mathematics.
Middle School Tournament
The 6th Annual GCTM Middle School Tournament was held at Thomson Middle School on April 22. Congratulations to the top six teams: 1st—Evans Middle School 2nd—First Presbyterian Day School 3rd—Fayette Middle School 4th—Trinity Elementary School 5th—Palmer Middle School 6th—Greater Atlanta Christian School

High School Tournament
The 2006 GCTM State Math Tournament was held at Mercer University on April 29 to determine the best math team in the state.

Thirty-three teams of four mathletes, as well as about a dozen individuals, participated in this tournament, which consisted of 3 parts. The written test contained 50 questions, 45 of which were multiple-choice. The questions covered the entire high school math curriculum, including calculus and statistics, and although calculators were needed for the written part of the test, not all questions were calculator active. After the written test, each person worked ten individual ciphering questions, which had to be completed in less than 2 minutes without technology. Then students paired up for the pair ciphering round, where each pair received 4 questions on which they could collaborate before submitting answers.

Top Individual Awards:

Top Teams:
1—Lassiter 2—Chamblee Charter 3—Pope 4—Rockdale Magnet 5—Centennial

Sample Questions from the 2006 GCTM State Tournament include:

Pair Ciphering:
The measures of the interior angles of a convex polygon form an arithmetic sequence. The smallest angle is 120° and the common difference is 5°. How many sides does this polygon have?

Individual Ciphering:
Let \( x < X \) represent the smallest integer \( n \) such that \( 2n > x \). Compute: \( \frac{17 + 10 \times 10}{-19} \)

Written Test:
1. The sides of a triangle are \( x, y, \) and \( x + y \). Find the measure of the largest angle in this triangle.
   - A) 60°
   - B) 100°
   - C) 120°
   - D) 150°
   - E) none of these

2. An urn contains \( N \) black marbles and \( N \) white marbles. These marbles are drawn from the urn randomly and without replacement. That is the value of \( N \) if the probability is 1/12 that all three chosen marbles are black?
   - A) 4
   - B) 5
   - C) 6
   - D) 7
   - E) 8

GCTM Math Tournament News

Georgia ARML Team Goes to Penn State

Consider the following problem:
If \( \tan(11x) = \tan(34°) \), and \( \tan(19x) = \tan(21°) \), compute \( \tan(5x) \).

I've just finished reading the 7th email about a proposed solution to this problem and this one involved the possibility (or impossibility) of complex values of \( x \). You're probably wondering what group of intellectuals cares so much about a problem like this. Well, this is the usual electronic communication that takes place among members of the Georgia American Regions Math League (ARML) team.

Each year after the state tournament, a dedicated group of math team coaches determines the 33 best mathletes in the state. The top 15 students are chosen to be the “A” team and the rest are usually underclassmen, chosen for their ability to help the team for several years. After practicing every Sunday afternoon in May, this group travels to Penn State University for the annual ARML contest. The actual contest is held simultaneously at three different sites and involves over 100 teams from all over the U.S. and Canada.

The ARML competition consists of 4 parts: the team round, power question, individual questions, and the relays. In the team round, all 15 members of a team are handed 10 questions to answer in 20 minutes. Students may collaborate and use calculators to determine the solution to these problems, but in order to score high, they must learn to work as a team and to use each other’s strengths. In the power round, the team is given a battery of questions on an unusual topic. Most of the power round questions consist of writing proofs, and the team gets an hour to complete this part. After this, all the students go to an auditorium to answer 8 individual questions. The questions are handed out two at a time and students have 10 minutes to answer each pair. After lunch, mathletes line up for the 3-person relays.

The Georgia ARML team has placed in the top 15 in the nation every year for the last 15 years, placing first once and third twice. Last year they placed 11th with a strong returning team.

At this year’s competition, the Georgia ARML team finished 8th (the B team finished 19th) out of 120 teams from all over the U.S., Canada, the Philippines, and Taiwan. Five Georgia students were in the run-off for a place among the top ten students in the nation.

ARML TEAM MEMBERS:

Wong, Carol (Chamblea Charter) Wui, Brayden (Monte de Sales) Wysolovski, Jonathan (Rockdale Magnet)

COACHES:
Brown, Jack (Paideia) Fulton, Tom (Wilson) Garnett, Chuck (Rockdale Magnet) Hedrick, Ben (Alphamath) Koppelman, Charles (Kennesaw State University) Marcus, Adam (Georgia Tech) Dom, Debbie (Lausanne) Sign, Steve (Paideia) Stan, Dom (Lausanne)
**Teacher Tips:**

**Trators and Gators**

Trators and Gators are the key to successful classroom management. I learned my skills on the job in a racially diverse, urban high school teaching at-risk students. I watched and learned from master-level teachers as they demonstrated a simple distillation of their Zen-like disciplinary skill.

Identify all Trators and Gators.

The brightly plumbed Trator is easily viewable in his natural environment. You’ll know a perpetrator within ten minutes of meeting him (males of the species are more prevalent than females). Your Day 1 Task! Identify and learn the names of all suspected Trators. They act out loudly and proudly, disrupting class with jokes, antics, and sometimes belligerence. Immediately ladle out copious quantities of consequences. “Nailing the Trator” allows you about a week of relative tranquility. Do not become complacent! Use this time to develop better seating arrangements; to learn the names, background, and abilities of your students; and to ingrain needed procedures into your classes so they can utilize technology without destroying it, navigate station activities, collaborate well in groups, and accomplish learning tasks during all types of instructional time.

And use this time to search for Gators. Gators have evolved a camouflage skin a chameleon would envy, and catching a glimpse of one in the wild is quite difficult. Diligent detection and catching a glimpse of one in the wild is quite difficult. Diligent detection and catching a glimpse of one in the wild is quite difficult. Diligent detection and catching a glimpse of one in the wild is quite difficult.

**DISCIPLINE TIPS FOR TRATORS**

1. **Warnings and Increments.**
   - Go slow, use warnings early (try one before class), and cover several incidents with one disciplinary measure.

2. **One-on-One.**
   - Trators are often clowns. Chat with Trators in the hallway or after class without the audience.

3. **Positive Reinforcement.**
   - Trators respond to praise. Labeled lifelong troublemakers, they have rarely heard teachers say nice things about them.

**DISCIPLINE TIPS FOR GATORS**

1. **Warning Signs.**
   - Five people laugh uproariously, but the nearby Trator is “paying attention.” Yeah, right. Call down Trator first, then the others.

2. **Public Discipline.**
   - Gator’s status depends upon secrecy. Add a longwinded speech to consequences.

3. **Inquest.**
   - Trators know to deny all wrongdoing, but get Gators talking. They spill trade secrets trying to convince you they are angels.

This issue’s “noteworthy” mathematician was born in 965 in the Persian city of Basra—now a part of modern-day Iraq. His full name is Abu-Ali al-Hassan ibn al-Haitham, which can be deciphered as “al-Hassan, the father of Ali, the son of al-Haitham.” He is generally known in the scientific literature as ibn al-Haitham (sometimes spelled “al-Haytham”), or by his Latinized name, “Alhazen.”

As a boy, ibn al-Haitham was especially interested in theology, but in time he became disillusioned by the differences he found between the various religious sects. He decided to devote his life to the pursuit of truth as revealed in mathematics and science.

Ibn al-Haitham lived in an age when the Muslim world was at the forefront of exact knowledge, and he had access to Arabic translations of the greatest classical scholars. As his knowledge and fame grew, it came to the attention of the current caliph of Egypt, al-Hakim, that ibn al-Haitham had proposed the building of a dam to control the Nile River. Al-Hakim invited ibn al-Haitham to Egypt to engineer and manage the project. However, once there, ibn al-Haitham saw that the project was hopeless, given the primitive engineering methods available to him.

Although al-Hakim was a patron of the arts and sciences, he was also a ruthless man, famous for handing out the death penalty for minor infractions. Afraid for his life, ibn al-Haitham faked insanity, and was put under house arrest until the death of the caliph.

Afterwards, he lived a modest lifestyle, supported partially by selling copies of and commentaries on the Greek classics. He died sometime around 1039 in Cairo, Egypt.

Ibn al-Haitham wrote approximately 200 works on subjects spanning mathematics, optics, astronomy, medicine, philosophy, and theology. After his death, he was accused of heretical beliefs, and many of his treatises were burned. Fortunately, some copies were apparently hidden away, and as a result, many of his most famous texts are still in existence.

Although his work was later studied by such luminaries as Galileo, Kepler, and Fermat, ibn al-Haitham is most famous for his geometrical problem in optics—what is now called the Alhazen Problem. Simply stated, imagine a circular mirror, and a point-like object. Where would an observer have to be situated so as to see the object in the mirror? Whereas Ibn al-Haitham solved the problem using conic sections, 18th-century mathematicians such as Isaac Barrow would approach it with the newly-invented analytic geometry.

Ibn al-Haitham used mathematics to solve physical problems (he is honored as the “father of optics”), but he was also interested in pure mathematics. He wrote at least 25 works on mathematics—including a commentary on Euclid—and was one of many scholars who attempted a proof of the parallel postulate.

Ibn al-Haitham joined the elite group of mathematicians honored on paper money in October of 2003, when the infamous Iraqi notes picturing Saddam Hussein were replaced by a new set of currency. Of the six new denominations that were released, only two bore portraits—the Babylonian lawmaker Hammurabi on the 25,000 dinar note, and ibn al-Haitham on the 10,000 dinar note. At the time of this writing the ibn al-Haitham design is still in circulation.
Wilson ‘Snowflake’ Bentley took over 6,000 photographs of individual flakes between the early 1880s and he found no two were alike. Just as snowflakes are different, the ways in which our students learn, think, and create are different too. If we are to develop our students’ potential, we must provide them with rich learning experiences that magnify their individual strengths and talents. Tomlinson (1999) tells us that a student’s potential is affected by the match between what they learn and how they learn. This is the focus of differentiation instruction. A differentiated classroom provides a ‘variety of avenues to content, process, products’ for all students (Tomlinson, 2006). It is where teachers provide specific ways for each individual to learn as deeply as and quickly as possible. According to Tomlinson (1999), it is providing multiple options for taking in information, making sense of ideas, and expressing what is learned. One student’s road map for learning is totally different from someone else’s (Tomlinson, 1999). What are the characteristics of a differentiated classroom? According to Tomlinson (2001), a differentiated classroom should include:

- Teacher sensitivity to the varying needs of learners
- On-going assessment
- Multiple learning options
- Variable pacing
- Respectful tasks for all learners
- Use of flexible grouping
- Teacher use of a variety of instructional strategies
- Varied modes of assessment
- Grading based on student growth or opportunity to demonstrate knowledge.

Three things to consider when differentiating: 1) readiness 2) interests and 3) learning profile.

**Readiness Strategies** include providing assignments for different levels, reteaching students having difficulty, demonstrating ideas or skills, providing organizers, providing key vocabulary, using more concrete examples, and using manipulatives.

**Interest Strategies** include providing interest stations that expand on topic, using examples and illustrations based on student interests, and using student questions to guide explanations.

**Learning Profile Strategies** include presenting in visual, auditory and kinesthetic modes, using applications, examples and illustrations from a wide range of intelligences, teaching with whole-to-part and part-to-whole approaches, and using wait time to allow for reflection (Tomlinson, p.7).

In addition, differentiation instruction should address four areas: content, process, product and learning environment.

**Content** consists of ideas, concepts, descriptive information, facts, rules, and principles that are presented to the learner. Content can be differentiated through depth, complexity, novelty, and acceleration. Examples of differentiating content include: learning contracts, technology, small group, and interest-based mini-lessons.

**Process** is the presentation of content, including the learning activities for students, the questions that are asked, as well as the teaching methods and thinking skills that are used. Examples of differentiating process or activities include student choice, learning contract, cubing (see example of cubed activity), tiered curriculum, and learning stations.

**Products** are the outcomes of instruction that consolidate learning and communicate ideas. Examples of differentiating products include independent study, tiered products (see fraction tic-tac-toe), and student choice.

**The learning environment** is the way the classroom looks and/or feels, the roles and relationships between and among students and teachers, the expectations for growth and success, and the sense of mutual respect, fairness, and safety present in the classroom. Examples of differentiating learning environment include class meetings, response journals, and established protocols.

Now that an overview of differentiation has been discussed, there are a few things to keep in mind that differentiation is NOT. Differentiation instruction is NOT individualized in structure, chaotic, or providing modifications (Tomlinson, 2001). Keeping in mind the four components mentioned above, a specific topic could be introduced to the whole group, several small groups, or individually. It may require that we manage and monitor several activities at once. Finally, if a student is in one group for reading or spelling, s/he may be in an entirely different group for mathematics. Grouping should be flexible utilizing ongoing assessment to provide direction for regrouping throughout the year.

Many teachers feel that this emphasis on differentiation instruction is another “thing” to implement for an already full and stressful agenda. The key is to begin at a pace that is challenging yet overwhelming. If we try to create 30 assignments for 30 students we will become frustrated and exhausted. Changing habits or patterns of teaching is difficult and stressful (Tomlinson, 2006). Just as teachers have their own special strengths, preferences and weaknesses, so do their students. The goal is for all students to obtain mastery over specific content (Van-Sciver, 2005). In order to accomplish this teachers need training and support in learning to differentiate instruction, assistance in establishing appropriate goals and timelines, support specialists, time for learning and planning, diversified materials, and supportive policies (Tomlinson, 2006).

To conclude, here is a list (certainly not inclusive) of helpful hints to keep in mind when planning differentiated lessons.

- Determine the learning style preference of students (noisy v. quiet space, lighted v. dark, oral v. visual channel, one spot v. flexibility to move around)
- Remember that students may or may not share the same learning preference as the teacher
- Have students determine their own preferences (learning style inventory or multiple intelligences test)
- Allow students to create their own ways to explore or express their ideas
- Think like a student
- Include student interests in curriculum ideas and materials
- Focus on essential skills and information
- Match the complexity of a task to a student’s skill and level of understanding

**Fa’teo** Think-Tac-Toe

<table>
<thead>
<tr>
<th>Illustrate problem using farm animals</th>
<th>Explain how to solve the problem two different ways</th>
<th>Create a new problem that would get the same answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tell a story using all of the numbers in the problem</td>
<td>List everything you know about how to solve this problem</td>
<td>Name each part of the problem and give another example for each</td>
</tr>
</tbody>
</table>

(A cube activity for solving word problems.)

CONT. ON PG. 24
Dice are not just for board games; they make great building blocks for several mathematical puzzles. One of the best-known mathematical puzzles is the PENTOMINO, so called because each of the flat pieces used are made of FIVE squares.

THE PENTOMINO PIECES

Because there are 12 possible shapes (all other shapes are just reflections or rotations of these shapes) of 5 squares (or cubes) each they can be used to:

- A rectangle of size 6 by 10
- A rectangle of size 5 by 12
- A rectangle of size 4 by 15
- A rectangle of size 3 by 20

Possible classroom activities:

- Using five sizeable squares or blocks have your students try to find all possible shapes in which all squares / blocks are connected by at least one side
- Order those shapes and eliminate reflections and rotations to produce a chart of Pentomino pieces (see above for an example)
- Have students make several Pentomino sets (arts and crafts project)
- Have (groups of) students find at least one solution for each of the possible rectangles that can be made with a full set of Pentomino pieces

The famous mathematician Piet Hein designed another puzzle, the SOMA CUBE, with seven pieces (four flat shapes and three three-dimensional shapes) built of cubes as follows;

THE SOMA PIECES

These pieces can be used to make a 3 by 3 by 3 cube. Discarding the 3 piece block, the remaining pieces can be used to make a cube with a hole straight through it.

A final thing to do with dice that does NOT involve luck is to make a set of four special dice with the patterns of dots like this:

A normal die has 21 spots of course; here a. has 16 spots, b. has 18, c. has 20 and d. has 18 again. You would think that die c. would win when used against any of the other three in a simple gambling game. Here is a game you would need these special dice for:

- Tell the student s/he will get a point for every throw in which her / his die wins and will lose a point for every throw in which the point value of the throw loses (note that there are no draws in this game)
- Tell the student that both of you will start with ten points and the game ends whenever one of you are out of points
- Let a student pick one of the dice first, allowing the student to study them

It is HIGHLY unlikely that the student will win; if you pick the correct die (the next in line, or a OR if the student picks d) you will win two out of every three throws!

I thought it might come in handy at some math tournament, but I really doubted that it would.”

And this is the reason that Matt worked on and off, whenever he had time or a new inspiration, on the problem.

Perhaps he was born with a math gene. His mother, Jody Johnson, teaches math at Mt. Pisgah Christian School and, according to Matt, she works math problems to calm down after a stressful day, and she doodles math formulas.

He first showed her his proof, and she returned it to him for editing. In fact, I received at least 3 “final versions” of this proof until he was satisfied that it was clear and complete.

“At first I thought there were four separate cases until I realized that a more general solution could solve all those problems,” Matt admits. “I kept revising the proof until all possible holes were filled.”

So what sort of student would take on this project for nothing more than curiosity? Matt Johnson is a brilliant, but well-rounded student. He just graduated with a 4.4 average, 9th in his class after scoring a perfect math score on the PSAT, SAT and SAT II. Due to his high scores on the American Math contest, he qualified for the AIME (American Invitational Math Exam) 3 of the 4 years in high school, and attended the Governor’s Honors Program in mathematics. He played trumpet in the band and was the treasurer of 4 clubs.

“With all that, I’m surprised I was able to find time to work on math problems.”
Teaching mathematical problem solving just got easier with the use of spreadsheets. Students can use real world numbers to answer questions that would not have been possible before. Teachers can empower students to get answers to complex math problems without tedious calculations. In the end, the student will better understand the math that they have been using in their computations for years.

So what do these problems look like? Will my students care about the answers they get? Let’s begin problem solving with bicycles. If your students ride their bikes to school, you can ask them to bring the bicycles into your classroom and use them to solve mechanical advantage problems. Ask them who they think has the fastest bike. Chances are they will have a variety of reasons why they think one bike may be faster than any of the others.

Next ask them if they think that the question can be answered by using math. What measurements should be taken?

- Does the length of the pedal or the radius of the wheel have anything to do with how far or fast the bicycle will go?
- Why is riding a bicycle faster and more efficient than walking or running?
- This activity is designed to help the students make the connection to the concept of mechanical advantage that they learned in science class. This concept can be illustrated in a simple fashion by looking at a “big wheel.” Have students calculate the distance pedaled (circumference of the circle made by the pedal rotation) in one rotation of the pedal and compare that with the corresponding distance traveled (circumference of the big wheel) in a spreadsheet.

If the formula for mechanical advantage (Mechanical Advantage = Distance Traveled/Distance Pedaled) is used, the students will be able to find the mechanical advantage of the big wheel. Once the students understand this illustration, they can begin to think about the measurements they need to calculate the mechanical advantage of each bicycle. Since the bicycle has a pedal that is separated from the wheel by a chain, there are other factors to consider. All of these factors can be entered into a spreadsheet. The students can create an algebraic equation that will find the mechanical advantage of any bicycle when standard measurements are taken and entered into the spreadsheet. This spreadsheet example is given in the illustration on the following page.

The students can compare the mechanical advantage of the bicycles and other factors such as rider size, height, and riding conditions to determine the best bicycle to buy. Students will then be able to use this information when shopping for bicycles or determining if a race is fair. As a challenge, students can also look at how bicycles with multiple speeds can adjust mechanical advantages to fit riding conditions.

With the power of spreadsheets, students can see number relationships and use real world data more efficiently. Instead of solving contrived problems with perfect whole numbers, they will be able to solve real problems with meaning and understanding.

WHY SHOULD I RIDE A BIKE?
Calculating the Mechanical Advantage of a Bicycle

<table>
<thead>
<tr>
<th>Length of Pedal</th>
<th>Radius of Pedal Gear</th>
<th>Radius of Wheel Gear</th>
<th>Radius of Tire Wheel</th>
<th>Distance Traveled</th>
<th>Distance Pedaled</th>
<th>Mechanical Advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>6</td>
<td>4</td>
<td>15</td>
<td>56.54866776</td>
<td>141.3716894</td>
<td>2.5</td>
</tr>
<tr>
<td>15</td>
<td>9</td>
<td>4</td>
<td>23</td>
<td>94.24777961</td>
<td>325.1548396</td>
<td>3.45</td>
</tr>
<tr>
<td>12</td>
<td>7</td>
<td>4</td>
<td>25</td>
<td>75.39822369</td>
<td>274.8893572</td>
<td>3.645833333</td>
</tr>
<tr>
<td>18</td>
<td>8</td>
<td>3</td>
<td>32</td>
<td>113.0973355</td>
<td>536.1651462</td>
<td>4.70470741</td>
</tr>
</tbody>
</table>

PI() indicates that Excel calculates PI correct to 15 decimal places. The teacher should stress that 3.14 is only an approximation for PI and that if you’re using a value for accuracy, you need more than two decimal places.

The excel template shown below is available by request. Please email bacallao_mk@mercer.edu.
Hamburgers and Probability: Appetizing Combinations

I can remember back in the 1970s when a popular fast-food chain came out with a jingle advertising its claim that it could make hamburgers in 256 different ways using these eight toppings: cheese, ketchup, lettuce, mayonnaise, mustard, onion, pickles, and tomato. When I teach probability, I ask my students if they think this claim is true, and, if so, how to verify it.

One approach to verifying this claim is to use the GPS Process Skills for problem-solving strategies - Solve a Simpler Problem and Make a List - using the abbreviations C = Cheese, K = Ketchup, L = Lettuce, MA = Mayonnaise, MU = Mustard, O = Onion, P = Pickles, and T = Tomato.

The customer has two choices for each topping on his hamburger with or without it. Using only the one topping Ketchup, then there will be two hamburgers possible with K or without K. Using only the two toppings Ketchup and Mustard, then there will be four hamburgers possible with these toppings K, MU, K and MU and without K and MU.

Using only the three toppings Ketchup, Mustard, and Onion, then there will be eight hamburgers possible with these toppings K3, MU3, K and MU3, K and MU, and O3, K and MU, and O, and K, MU, and O.

The students can draw the following table showing the number of ways it is possible to make hamburgers from the lists for 1, 2, and 3 toppings.

<table>
<thead>
<tr>
<th># of Toppings</th>
<th># of Hamburgers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 = 2^1</td>
</tr>
<tr>
<td>2</td>
<td>4 = 2^2</td>
</tr>
<tr>
<td>3</td>
<td>8 = 2^3</td>
</tr>
</tbody>
</table>

Using the problem-solving strategy Look for a Pattern, the students can continue the table without having to make lists for 4, 5, 6, 7, and 8 toppings.

<table>
<thead>
<tr>
<th># of Toppings</th>
<th># of Combinations</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1 = C0</td>
</tr>
<tr>
<td>1</td>
<td>2 = C1</td>
</tr>
<tr>
<td>2</td>
<td>4 = 2C2</td>
</tr>
<tr>
<td>3</td>
<td>8 = 2C3</td>
</tr>
<tr>
<td>4</td>
<td>16 = 2C4</td>
</tr>
<tr>
<td>5</td>
<td>32 = 2C5</td>
</tr>
<tr>
<td>6</td>
<td>64 = 2C6</td>
</tr>
<tr>
<td>7</td>
<td>128 = 2C7</td>
</tr>
<tr>
<td>8</td>
<td>256 = 2^8</td>
</tr>
</tbody>
</table>

The sum of the two terms above is the term below. The sum of the last row of numbers listed in the triangle above yields 1 + 8 + 28 + 56 + 70 + 56 + 28 + 8 + 1 = 2^8 = 256, which is the number of possible combinations for eight toppings.

In general, the sum of all of the terms in the row of Pascal’s Triangle beginning 1, n, . . . is equal to 2^n.

The sum of the terms in each row is a power of two. Each row of Pascal’s Triangle can be rewritten in terms of combinations. Simplifying each of the combinations in the triangle above results in Pascal’s Triangle.

My students are always interested in seeing the lists that I made of the 256 possible combinations to illustrate the problem and to enhance their understanding of the results of their computations.

For a copy of these lists, please visit the GCTM Web site at www.gctm.org.

Students can find many interesting properties in the triangle. For example, the rows are palindromes, which read the same forwards and backwards.

The formula for combinations is

\[ C_n^r = \frac{n!}{r!(n-r)!} \]

which represents the number of combinations of n things taken r at a time. By definition 0! = 1.

In this case, n equals 8, which is the number of toppings, and r equals the number of toppings used together at a time from 0 to 8.

<table>
<thead>
<tr>
<th># of Toppings</th>
<th># of Combinations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 = C0</td>
</tr>
<tr>
<td>2</td>
<td>1 = C0 + 1 = C1</td>
</tr>
<tr>
<td>3</td>
<td>1 = C0 + 2 = C2 + 1 = C1 + 2 = C3</td>
</tr>
<tr>
<td>4</td>
<td>1 = C0 + 3 = C2 + 2 = C4</td>
</tr>
<tr>
<td>5</td>
<td>1 = C0 + 4 = C2 + 3 = C5</td>
</tr>
<tr>
<td>6</td>
<td>1 = C0 + 5 = C2 + 4 = C6</td>
</tr>
<tr>
<td>7</td>
<td>1 = C0 + 6 = C2 + 5 = C7</td>
</tr>
<tr>
<td>8</td>
<td>1 = C0 + 7 = C2 + 6 = C8</td>
</tr>
</tbody>
</table>

The sum of the terms above is 256.

For a copy of these lists, please visit the GCTM Web site at www.gctm.org.

This NCTM electronic journal is free to everyone until June 2007. It is a collection of interactive articles that are available for classroom use.

http://my.nctm.org/eresources/journal_home.asp?journal_id=6

OBJECTIVES

The Objectives of the Georgia Council of Teachers of Mathematics are

to encourage an active interest in mathematics and
to act as an advocate for the improvement of mathematics education at all levels.
Reflections Fall 2006

THE GPS FRAMEWORK: Have you seen it? The Seventh Grade Framework has now joined the Sixth Grade Framework on the Web at www.georgiastandards.org with plans in progress to have frameworks for K-5, grade 8, Math 1, and Math 2 on the Web in the fall. These mathematics frameworks help to define the depth and rigor expected of all Georgia students. Prior to exploring these frameworks, plan to read the introduction which clarifies their purpose, explains their organization, and summarizes the principles inherent in a standards based classroom.

There are four major components to the GPS: 1) the standards and elements, 2) tasks, 3) student work, and 4) teacher commentary. At the moment, both the sixth and seventh grade frameworks are composed of excellent tasks. However, there is still a great need for more student work. Should you be willing to submit student work, please contact Desha Williams at dwilliams@gzu.edu or Peggy Pool at ppool@gctm.org. Not only may these be used within the frameworks, but GCTM will also be showcasing samples of student work at Rock Eagle in October.

Thank you to all of the committee members and others who have helped and will help to improve each unit. Collaborating and working together, we are not only improving student achievement in mathematics; we are improving the lives of our students along with the future of our state, our country, and the world.

UNDERSTANDING THE GEORGIA PERFORMANCE STANDARDS IN MATHEMATICS

As our sixth grade teachers will attest, the Georgia Performance Standards in Mathematics are here! Kindergarten, first grade, second grade, third grade and seventh grade will also be experiencing them with full implementation during this coming school year. They have been posted on the web for a while now. Teachers across Georgia have read them and understand that there are many changes in their discipline, particularly in grades 7-12. However, that is only a small piece of the changes that are being made in the classrooms across our state as we implement our GPS. Other areas that are experiencing change in the classroom are summarized below.

1—High expectations are the same for every student. No longer will some students be excused from learning because of their personal characteristics, backgrounds or physical challenges.

2—Students will see that mathematics is important because each new idea links to other ideas and it is a part of a series of isolated bits and pieces. Instruction will build on “big ideas” in meaningful ways.

3—Teachers will encourage students to think, question and solve problems. Students should be motivated to try different ideas, strategies, representations and solutions and discuss these with their peers. Learning will take place because of the experiences that the teachers provide within the classroom.

4—Although computation is important, students will be required to go beyond computation to think and reason mathematically. They will learn mathematics with essential understandings that will make it possible for them to solve new problems and learn new ideas that they will face in the future.

5—Assessment is no longer of learning, but for learning! Teachers must continually gather information about student growth and understanding, use a variety of assessment techniques and have a good idea of how their students may be thinking about the mathematics being developed. This means that assessment must be ongoing and include effective feedback.

6—Technology should not be used as a crutch, but as a tool to enhance learning. Through the use of calculators and computers, students may be able to explore new ideas, work with a broader range of problems, and bypass less important procedures when developing more advanced concepts.

This means that no longer will the teacher be doing all of the work within the classroom. Instead, students will be engaged in meaningful tasks with the teacher as a facilitator. They will take pride in their mathematical thinking power and enjoy learning mathematics within the classroom setting. Wow! Isn’t this why we became teachers? What an exciting time to be in education!

Georgia Performance Standards in Mathematics

Quotes from Sixth Grade Teachers Across Georgia after the First Year of GPS Implementation

“I saw students become better problem solvers as they were able to use various strategies. I believe my students learned a lot because the standards are higher.” —Rita Pickens, Banks County

“Teachers are sharing within a grade and vertically much more, resulting in a collaboration of resources and knowledge which we haven’t ever seen before.” —Karen McGuire, Union County

“Students have taken ownership in their learning. They have learned to think about the ‘whys.’ The GPS have brought a higher level of active engagement into our classroom.” —Rodlyn Wells, Richmond County

“Mathematics GPS makes sense on so many levels! No longer passive learners, they are being trained by GPS to expect the struggle that is a part of meaningful learning. We are working to support logical/mathematical empowerment and agility!” —Lianna Nix, Jasper County

“Teachers in Sumter County and across the state are beginning to ‘think outside of the box’ and use ordinary, everyday items and events to teach extraordinary lessons in mathematics. Once the teachers make the connections, students tend to enjoy mathematics and overcome their fear of the subject.” —Gayla Brasel, Sumter County

“My students did more communicating with one another and learned to be less dependent upon the teacher. The students didn’t realize when we were doing a performance task, they just thought we were having fun.” —Jessica Bramlett, Tifton City

“When they learn the why and really understand, it opens their eyes to a new world that some have never experienced before.” —Pam Quinn, Chickamauga City Schools

Peggy Pool

Georgia Performance Standards in Mathematics

Reflections Fall 2006

Reflections Fall 2006
CONT. FROM PG. 15
—Make sure students have adequate structure, challenge and clarity of purpose and expectations for assignments (Tomlinson, 2001).

Push me! See how far I got
Work me ‘til I drop. Then pick me up.
Open a door, and then make me run to
assignments (Tomlinson, 2001).

Purpose and expectations for
—Make sure students have adequate

Georgia.

—Harriet lives in Gainesville and teaches Honors Geometry and AP Calculus at Chestatee High

—Greg is an Associate Professor of Mathematics Education in the Department of Teaching and

School. She will retire in December of this year.

—Cheryl Hughes is the mathematics department chair at Landmark Christian School in Fairburn, where she teaches Geometry and Honors Geometry. She has been the editor of Reflections since 2000.


References


1 The 3 by 20 rectangle has just TWO possible solutions, not counting rotations and reflections.

2 This is because 3, 4, 5 is known as a Pythagorean triplet, a (the smallest in fact in this case) solution in “natural numbers” of famous formula \(a^2 = b^2 + c^2\).
MathFest is an extended math initiative that motivates students, parents, and teachers to raise the both standards and expectations in mathematics, and it is having a positive impact on elementary school students who participate in the event. There have been definite improvements in math achievement since this program began at E.W. Oliver Elementary School in Riverdale, Georgia. In its fifth year, this event is the creation of Dr. Ron K. Boykins, principal of Oliver Elementary. His philosophy is that "we can make kids competitive by making them compete. To change our attitudes on math, we need to start when our kids are young."

The competition this past March was held at Clayton State University and attracted about 800 students in Kindergarten through 6th grade. MathFest has provided the motivation, rigor, and comprehensive push that many students need to accomplish more in math.

MathFest provides both a motivation for students to learn and practice mathematics and opportunity for them to compete. This program not only increases student achievement by pushing students to become more competitive, it also encourages them to focus on math skills which will enable them to be more competitive in this nation's highly technological society.

MathFest provides the rigor, community resources, training, motivation, collaboration, and comprehensive development necessary to improve mathematics education nationally.

**COMPONENTS:**

1. Practice Sessions are held in individual schools for 2-3 months. These consist of practice problems for each grade level that are formatted like those in the CRCT. Students who answer at least 75% of the problems correctly are invited to an incentive activity. Those activities motivate the students to do their best during the practice session.

2. Testing Sessions are conducted at each grade level. The tests are formatted similarly, and at least 25% of the problems are one grade level above the testing level. Students receive this testing over a 3-week period. These tests are used to determine which students will move to a competitive session.

3. Competition day is attended by the students with the highest composite total from each grade level during the testing sessions. On MathFest Competition Day, students from each grade level are positioned in the testing area for assessment.

Students show their answers to the problems by writing their responses on individual dry erase boards. All students are given the same amount of time to complete the problems. There is no score reward for speed. They are encouraged to check their work if they finish early. Calculators are not used in the competition.

4. Also on Competition Day there are:

   a. Math Instruction—Each school brings creative lessons to motivate and educate students about the value of math.

   b. Fun-Day Activities—Each school sets up a math activity table where students solve problems and win small prizes in a real world type of math setting.

   c. Mock Math and Science Job Fair—Students visit displays and participate in mock interviews for math-related jobs.

MathFest 2007 will be held in Atlanta on March 24. It is anticipated that there will be 10,000 elementary students participating in this spectacular event. Mathematics educators from all over the world will be gathering in Atlanta at that time for the annual meeting of the National Council of Teachers of Mathematics, and they will be invited to witness this exciting competition, the largest math extravaganza on earth for elementary students.

When President Bush first signed No Child Left Behind, every educator’s attention turned to reading and research-based programs. Math, unfortunately, was put on the sidelines. Now, four years later, the nation is shifting its attention to mathematics education and finding new ways to engage students in this subject that too few of our students have had to opportunity to learn well.
APPLICATION

Date ____________________________

Name ____________________________________________

Mailing Address ____________________________________________

City ____________________________ Zip __________ Email ____________________________

Home Phone ____________________________ Work Phone ____________________________

Indicate your GCTM region: ☐ NW ☐ NE ☐ CW ☐ CE ☐ MW ☐ ME ☐ SW ☐ SE

PreK-12

Position (Grade Level) ____________________________ School ____________________________

System __________________________________________________________________________

Post Secondary

University/College/Technical Institute ____________________________

Position ____________________________

Student Membership

College/University ____________________________ ☐ Junior ☐ Senior

Graduation Date ____________________________

☐ Renewal GCTM Membership Number ____________________________

☐ New GCTM Regular Membership ($20) $ __________

GCTM Life Membership ($400) $ __________

GCTM Student Membership (Pre-Service Teachers) ☐ FREE (Faculty Advisor Signature)

GCTM Affiliate $ __________

My Contribution to Georgia Mathematics Education Trust $ __________

Applicant’s Signature (required) ____________________________

Mail to: Susan Craig

GCTM Membership Director

1011 Stewart Ave.

Augusta, GA 30904-3153
IMPORTANT DATES TO REMEMBER

Get Out Your Calendars, Day Planners, and PDAs

GCTM Annual Conference at Rock Eagle
October 19 - 21, 2006

NCTM Annual Conference in Atlanta
March 21 - 24, 2007

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