Louisiana Association of Teachers of Mathematics

LATM Journal

Volume 7

Academic Year 2010-2011

The LATM Journal is a refereed publication of the Louisiana Association of Teachers of Mathematics (LATM). LATM is an affiliate of the National Council of Teachers of Mathematics (NCTM). The purpose of the journal is to provide an appropriate vehicle for the communication of mathematics teaching and learning in Louisiana. Through the LATM Journal, Louisiana teachers of mathematics – and all teachers of mathematics – may share their mathematical knowledge, creativity, caring and leadership.

Editorial Staff

Submission Guidelines

The following guidelines should be followed when preparing a submission:

- Manuscripts should be submitted electronically to dplaisance@nicholls.edu
- Articles should be written in Microsoft Word© and double spaced. Graphics should be computer-generated and embedded in the document.
- Articles must include a brief abstract/summary, preferably single-spaced.
- A template for articles may be requested from D. Plaisance at dplaisance@nicholls.edu
- Provide a statement (with your article) guaranteeing that the article has not been published or submitted elsewhere.
- Include a cover letter with your name, preferred mailing address, FAX number, e-mail address, telephone number, and institutional affiliation.
- Include a brief autobiographical sketch of five sentences or less.
- Suggestions for revisions by reviewers will be submitted to authors prior to final approval for acceptance. Revision of articles will be reviewed and approved by editors. Editors are responsible for final selection of articles.

Submission of manuscripts throughout the calendar year is strongly encouraged to allow time for careful review and, if necessary, revision of the proposed articles. Publication of the LATM Journal is annual and is anticipated by February of each year. Approximate deadline for submission of articles is October 1. Presently, links to past issues of the LATM Journal can be located at http://www2.selu.edu/orgs/LATM/. In the future, links to issues will be found at http://www.lamath.org/.

LATM Executive Council

President	Past-President
Beth Smith **Monroe** bethsmith1124@gmail.com	**Maryanne Smith** **Mandeville** smith70471@yahoo.com

Vice-President Elementary	Vice-President Middle School	Vice-President High School	Vice-President College
Sabrina Smith **Harvey, LA** sabsmith@cox.net	**Kathryn McInnis** **Covington, LA** katlyn5mac@yahoo.com	**Penny Gennuso** **Scott, LA** mscromath@aol.com	**Jeffrey Weaver** **Baton Rouge, LA** jtweaver81@hotmail.com
Secretary	**Treasurer**	**NCTM Representative**	**Membership Chairman**
Stacy Magee **Abita Springs, LA** stacey.magee@stpsb.org	**Nell McAnelly** **Baton Rouge** mcanelly@math.lsu.edu	**Ellen Daugherty** **Baton Rouge, LA** edaugh1@lsu.edu	**Vicky Hand** **Lake Charles, LA** vicky.hand@cpsb.org

LATM Journal Coordinator	Newsletter Editor	Webpage Editor
DesLey Plaisance **Baker, LA** desley.plaisance@nicholls.edu	**Carolyn Sessions** **Baton Rouge, LA** carolyn.sessions@la.gov	**Suzanne Buras** **Covington, LA** saburas@bellsouth.net
Parliamentarian	**Presidential Awards Coordinator**	**LDE Representative**
Jacob Hesselschwardt **Shreveport, LA** jacobhessel@yahoo.com	**Jean May-Brett** **Kenner, LA** jam05@bellsouth.net	**Kim Melancon** **Maurepas, LA** kim.melancon@la.gov

LATM Executive Council
Affiliate Representatives

Acadiana Council of Teachers of Mathematics ACTM **Cat McKay** **Lafayette, LA** cmckay7930@earthlink.com	**Baton Rouge Area Council of Teachers of Mathematics BRACTM** **Shannon Hannaman** **Baton Rouge, LA** shannama@lsu.edu
Greater New Orleans Teachers of Mathematics GNOTM **Joan Albrecht** **Harvey, LA** joan.albrecht@jppss.k12.la.us	**Louisiana Council of Supervisors of Mathematics LCSM** **Emily Rash** **Monroe, LA** erash@comcast.net
NorthEast Louisiana Association of Teachers of Mathematics NELATM **Pam Martin** **Bastrop, LA** 2975mart@bellsouth.net	**Northwest Louisiana Mathematics Association NLMA** **Tonya Evans** **Shreveport, LA** tevans@caddo.k12.la.us
SouthEast Louisiana Association of Teachers of Mathematics SEATM **Ellen Marino** **Mandeville, LA** ejmarino@bellsouth.net	**SouthWest Louisiana Teachers of Mathematics SWLTM** **Kay Kussman** **Lake Charles, LA** kkussman@mcneese.edu

Table of Contents

Adventures in Fraction Addition

J. Bradford Burkman
Louisiana School for Math, Science, and the Arts
Andover Summer Session, Phillips Academy

Abstract:
A high-school mathematics teacher in Louisiana reviews the last two years of his continuing exploration of fraction addition, especially how to find an “ideal” set of exercises to review arithmetic skills, but also other applications for his lessons and ideas to stimulate himself intellectually.

Two years ago I became fascinated with fraction addition. Not advanced topics like the partial-fraction decomposition of powers of rational functions, but just ordinary, elementary-school, addition of ratios of small integers. In my investigations of fractions I've found not only “ideal” sets of exercises for my students, but done some interesting adult math and found some intermediate levels my students can understand.

My adventures in fraction addition began with the exercise

$$\frac{1}{6}+\frac{1}{10}=\frac{1}{2\cdot 3}+\frac{1}{2\cdot 5}=\frac{5+3}{2\cdot 3\cdot 5}=\frac{8}{2\cdot 3\cdot 5}=\frac{2\cdot 4}{2\cdot 3\cdot 5}=\frac{4}{3\cdot 5}=\frac{4}{15}$$

I had always believed that if you used the least common denominator the sum would not reduce; apparently not true. The dynamics in this example could just be “odd plus odd is even.” Are there fraction addition exercises whose sum reduce by factors other than 2? These three exercises' sums reduce by 3, 4, and 5, respectively.

$$\frac{5}{12}+\frac{1}{30}=\frac{27}{2\cdot 5\cdot 6}=\frac{9}{2\cdot 5\cdot 2}=\frac{9}{20} \qquad \frac{7}{20}-\frac{5}{28}=\frac{24}{4\cdot 5\cdot 7}=\frac{6}{35} \qquad \frac{7}{20}-\frac{6}{35}=\frac{25}{4\cdot 5\cdot 7}=\frac{5}{28}$$

In fact for each integer $n>1$ there are exercises whose sum reduces by n.

So I looked at the general fraction-addition exercise to understand its dynamics. Think of each exercise as $\frac{a}{ce}+\frac{b}{de}$, where a, c, d, and e are positive integers, b is a nonzero integer ($b<0$ makes a fraction subtraction exercise), e is the greatest common divisor of the denominators, so c

and d are relatively prime (gcd(c,d)=1), and the two fractions separately are irreducible, so gcd(a,c) = 1, gcd(a,e)=1, gcd(b,d)=1, and gcd(b,e)=1. The least common multiple of the denominators is cde, so $\frac{a}{ce}+\frac{b}{de}=\frac{ad+bc}{cde}$.

In order for the sum to reduce, $ad+bc$ has to have a common factor with c, d, or e. In the numerator, a and d are each relatively prime to c, so ad is also. The sum of a number relatively prime to c and a multiple of c is relatively prime to c, so $ad+bc$ is relatively prime to c; therefore, the sum will not reduce by a factor of c; similarly for d. That leaves e. Note that the numerator has no relationship to e. To construct a fraction-addition exercise that reduces by n, find a linear combination $ad+bc$ that is a multiple of n, call it np, (with the relatively-prime restrictions on a, b, c, and d above), and choose e to be another multiple of n, nq, such that gcd(p,q)=1 in order that gcd(np,nq)=n. For example, to get an exercise reducible by n=7, we could use a=1, b=3, c=3, and d=5, giving $ad+bc$=14 = np with p=2. Let e=21= nq with q=3, giving $\frac{1}{3\cdot 21}+\frac{3}{5\cdot 21}=\frac{5+9}{3\cdot 5\cdot 21}=\frac{14}{3\cdot 5\cdot 21}=\frac{2}{3\cdot 5\cdot 3}=\frac{2}{45}$.

Intellectually stimulating, but how is this understanding going to benefit my students? Let's look back at the exercise $\frac{7}{20}-\frac{6}{35}$.

In small steps, $\frac{7}{20}-\frac{6}{35}=\frac{7}{4\cdot 5}-\frac{6}{7\cdot 5}=\frac{7\cdot 7-6\cdot 4}{4\cdot 5\cdot 7}=\frac{49-24}{4\cdot 5\cdot 7}=\frac{25}{4\cdot 5\cdot 7}=\frac{5\cdot 5}{4\cdot 5\cdot 7}=\frac{5}{4\cdot 7}=\frac{5}{28}$.

In this exercise, the student has practiced all of the usual fraction-addition skills, including factoring, finding a greatest common factor, finding a least common denominator, and reducing, but the student has also practiced arithmetic of integers, including 4·5=20, 7·5=35, 7·7=49, 6·4=24, 49-24=25, 5·5=25, and 4·7=28.

Every year I teach a second-year algebra course, the lowest-level math course at my school, so all of the students are new to the school. Most of the students became so calculator-dependent at their previous schools that they forgot arithmetic of integers. If I want to teach them operations like $(2x+7)(4x+9)$, they first need to understand $27\cdot 49$, the special case where $x=10$. So we start the semester with arithmetic review, and fraction addition is just mysterious enough that I can use it as a Trojan horse to get them to practice arithmetic of integers without deflating their egos.

To choose exercises I asked, "What do I mean by a `good' fraction-addition exercise?" For my students, I wanted practice in the multiplication table through 9 and multiplication by 10, with no long multiplication. So I wanted a, $|b|$, c, d, and e in $\{1, 2, 3,..., 9\}$. To exclude exercises that require long multiplication, let $g = \gcd(ad+bc, e)$, the factor by which the sum reduces. The sum $\frac{ad+bc}{cde}$ reduces to $\frac{(ad+bc)/g}{c\cdot d\cdot e/g}$. In order that the operation $(c)(d)(e/g)$ does not require long multiplication, either one element is 1 or the student can group them into two multiplication exercises in [2,9] x [2,9]. I excluded exercises whose numerators had a common factor, like $\frac{2}{3}+\frac{2}{5}$, because it is susceptible to the method $2\left(\frac{1}{3}+\frac{1}{5}\right)$, which I want to teach separately.

How many such exercises are there? Make a list; there are about six thousand. Some other criteria, like not wanting one fraction in an exercise to have a denominator of 1 or the two denominators to be the same, get it down to about five thousand.

When we have students practice fraction addition, we don't assign just one exercise. What would it even mean to have a "well-rounded set"? For the Trojan horse goal I have of practicing the multiplication table, the best set would be one that practiced each of the thirty-six elements of the [2, 9] x [2, 9] table at least once. Is there a smallest such set, and how would we find it? The exercise we examined earlier, $\frac{7}{20}-\frac{6}{35}$, practiced five elements of the multiplication table. We want thirty-six. Perhaps we would need only eight exercises to cover the table.

The difficulty again comes from "relatively prime." An exercise can contain a product of two numbers with a common factor, like 3·6, but we can't have two products with the same common factor, like 3·6 and 3·9, in the same exercise. Most importantly, the ten Even·Even multiplication-table elements, 2·2, 2·4, 2·6, 2·8, 4·4, 4·6, 4·8, 6·6, 6·8, and 8·8, must each appear in a different exercise, so we need at least ten exercises.

Now that we know how many exercises we need, how would we search for such a set? How many combinations of ten different things can we choose from five thousand? About 10^{33}, which is "many." If we're looking for exactly one exercise for 2·2, one for 2·4, … then the number of combinations is (the number of exercises with 2·2) x (the number of exercises with 2·4) x ⋯ , which is about 10^{21}, a trillionth as many, but still "many."

My laptop processor was not powerful enough to test the combinations, so I contacted the Louisiana Optical Network Initiative (LONI) and the Center for Computation and Technology at LSU, which bent over backwards to give me access and training on their computer clusters. Using a hundred processors simultaneously for days on end let me explore these combinations and better understand how the exercises interact in a set. After a few months working on LONI I was able to improve my search algorithm from a brute-force attack into something more efficient that runs on one processor in my laptop in a few hours.

Here's what I consider an "ideal" set of exercises for my students.

1. $\frac{7}{6} - \frac{5}{36}$ 2. $\frac{3}{10} + \frac{7}{12}$ 3. $\frac{9}{40} - \frac{5}{48}$ 4. $\frac{1}{24} + \frac{7}{30}$

5. $\frac{8}{5} - \frac{9}{8}$ 6. $\frac{4}{9} + \frac{5}{12}$ 7. $\frac{1}{20} + \frac{1}{36}$ 8. $\frac{4}{63} + \frac{7}{72}$

9. $\frac{7}{18} - \frac{8}{27}$ 10. $\frac{1}{24} - \frac{1}{56}$

In this set, the student practices each element of the [2,9] x [2,9] multiplication table at least once, addition five times, three of those with carrying from the ones to the tens column, and subtraction five times, three of those with borrowing. There is also a variety of types of denominators; one exercise (#5) has relatively prime denominators, one (#1) has one denominator a multiple of the other, and the other eight have "robust" denominators, where the two denominators do have a common factor which is neither of the denominators. Four of the ten sums reduce, each by a different factor (#4 by 3, #7 by 2, #8 by 9, and #10 by 4).

I consider this set to be a well-rounded set, practicing a variety of skills in the fewest possible number of exercises. Reasonable people can disagree about what skills a student should practice, but as long as we're assigning skills practice for homework, the homework should be engineered to use the students' time effectively. We don't want homework to be busywork. Make a list of the skills you want the students to practice, and find the smallest number of exercises that will give the practice you want.

Two summers ago I went to my math/science librarian and asked to see everything written in the last twenty years on how to write good sets of fraction-addition exercises. I expected to spend the rest of the summer working through a large pile of journal articles and book chapters. Nothing. I emailed academics, and nobody is working on the topic. It seems that the only people interested in how to write exercises are the textbook (and online course) publishers, whose methods are proprietary. Are the sets of exercises in our textbooks carefully written using the latest ideas and technology, or just copied from old books? We don't know.

This year I'm using fractions much more in my second-year algebra course. At the beginning of the year we used sets of exercises like the one above to review basic arithmetic. We've also learned the Euclidean Algorithm for finding the greatest common divisor. To find the least common denominator in $\frac{8}{153}+\frac{7}{408}$, the student needs to first find the greatest common divisor of 153 and 408. Using Euclid's algorithm in modern notation, 408 mod 153 = 102, 153 mod 102 = 51, 102 mod 51 = 0, so gcd(153,408) = 51, so $\frac{8}{153}+\frac{7}{408}=\frac{8}{3\cdot 51}+\frac{7}{8\cdot 51}=\frac{8\cdot 8+7\cdot 3}{3\cdot 8\cdot 51}=\frac{85}{3\cdot 8\cdot 51}$. If the sum reduces, it reduces by a factor of 51, so apply the Euclidean Algorithm again to find gcd(85,51): 85 mod 51 = 34, 51 mod 34 = 17, 34 mod 17 = 0, so gcd(85,51) = 17, so $\frac{85}{3\cdot 8\cdot 51}=\frac{5\cdot 17}{3\cdot 8\cdot (3\cdot 17)}=\frac{5}{3\cdot 8\cdot 3}=\frac{5}{8\cdot 9}=\frac{5}{72}$.

To my surprise, several of my students have embraced the Euclidean Algorithm and use it frequently. I would rather they knew the multiplication table thoroughly enough to know gcd(49,28) immediately, but using Euclid is good practice.

Finding least common multiples efficiently applies not only to finding common denominators, but also to eliminating variables in systems of equations.

Later this year we'll use the same Euclidean Algorithm to do the algebra version of fraction addition, like $\frac{2x-3}{6x^2+19x+10}+\frac{4x+7}{24x^2+43x+18}$. The same rules about common factors canceling apply. To find the greatest common factor of the denominators, one could factor, but that method does not extend to denominators that don't factor conveniently [whatever you mean by "conveniently"]. $(24x^2+43x+18)\text{mod } 6x^2+19x+10=-33x-22=-11(3x+2)$,

$(6x^2+19x+10) \bmod 3x+2=0$, so $\gcd(24x^2+43x+18,\ 6x^2+19x+10)=3x+2$.

$$\frac{2x-3}{6x^2+19x+10}+\frac{4x+7}{24x^2+43x+18}$$

$$=\frac{2x-3}{(2x+5)(3x+2)}+\frac{4x+7}{(8x+9)(3x+2)}$$

$$=\frac{(2x-3)(8x+9)+(4x+7)(2x+5)}{(2x+5)(8x+9)(3x+2)}$$

$$=\frac{24x^2+28x+8}{(2x+5)(8x+9)(3x+2)}$$

$$=\frac{4(2x+1)(3x+2)}{(2x+5)(8x+9)(3x+2)}$$

$$=\frac{4(2x+1)}{(2x+5)(8x+9)}$$

With a thorough understanding of how fraction addition works, this exercise is much easier.

My exploration began with one fraction-addition exercise whose reducing defied my expectations, and has grown into a personal review of some real math and new ideas for my classes. It's been a productive journey. Anyone interested in collaborating on further investigation please contact me.

J. Bradford Burkman (bburkman@lsmsa.edu) has taught mathematics at LSMSA (Louisiana School for Math, Science, and the Arts) since 2003, and taught in the Andover Summer Session at Phillips Academy since 1999. He studied English at Wheaton College (IL), became interested in teaching mathematics when he was private tutor to an Indian expatriate family living in China in 1998, and studied mathematics at SUNY Buffalo. He presented the ideas in this article at the MAA MathFest 2010, and spoke on using arithmetic of integers as a bridge to arithmetic of polynomials in the Developmental Math session at the AMS/MAA Joint Meetings in New Orleans in January 2011.

Closing the Achievement Gap: Using Block Scheduling to Support Struggling Math Students

Richard M. Hearn
Curriculum Coordinator
Ouachita Parish High School

Jeanne A. Clark
Math Department Head
Ouachita Parish High School

Abstract:
Successful schools are those that constantly search for the means to better serve all of its students. This is a tremendous undertaking as within each school's population, there are groups of students that provide significantly greater challenges than others. When the achievement levels of these subgroups decline or become stagnant, successful schools will abandon those strategies that have been proven ineffective in promoting the academic success of struggling learners and seek out those strategies that will. Assignment of a school's most gifted teachers to provide instruction to the learners most in need of quality instruction through the creative use of block scheduling is one way that Ouachita Parish High School is addressing the achievement gaps that exist between high- and low-performing subgroups. The use of this strategy has resulted in immediate gains in the student achievement on classroom and standardized assessments and in the number of one-year algebra completers.

In the fall of 2008, the instructional leadership team at Ouachita Parish High School asked the question: "What would happen if a school's most highly qualified teachers were used to teach the students most in need of high quality instruction?" The obvious answer to that question, increased student achievement, was indeed found to be the case. Reversing the trend of "rewarding" veteran teachers with classes of advanced students, these teachers, who were most capable of supporting at-risk students, were given the opportunity to do just that. It is important to note that these teachers were not simply placed in classrooms full of "needy" students. That might have been interpreted as some form of punishment for longevity or taking part in professional growth and could have then provided a counter-incentive to other teachers to simply do nothing in terms of developing or demonstrating their own proficiencies. Instead, each of these highly regarded teachers was given one class of at-risk students to support and develop throughout the course of the school year.

The decision to spread these classes out among several veteran teachers was made for a couple of reasons with one being to promote teacher buy-in. After all, any teacher that has been teaching advanced students for some time could reasonably have reservations about giving up these students who are the epitome of what most educators would hope to find in their classrooms. They are largely conscientious, self-motivated, able and willing to participate in classroom activities, and receive adequate parental support of their academic endeavors. Struggling students on the other hand, often lack mastery of fundamental language or mathematical skills, act out to take the focus off their academic shortcomings, rarely participate in classroom activities, and do not receive high levels of parental support. This second group of students requires a great deal of effort on the part of the teacher to simply motivate toward classroom engagement. Being mindful of these differences, each teacher received only the one class, albeit the two-hour block, where a maximum of 15 students would be served by the best our school had to offer.

While the student population at Ouachita Parish High School is split almost evenly in racial distribution, students that are identified as struggling learners are disparately from two historically low-performing subgroups. It will not surprise most educators that those most in need of support are African-American students from low socio-economic backgrounds. In the five years prior to this endeavor, math proficiencies for these students have hovered at or under 50 percent compared to over 80 percent for white students. An immediate impact was seen on the 2009 administration of the iLEAP with a 4 percent increase in the number of students passing the assessment; a 5 percent increase in the number of students reaching proficiency; and a 6 percent increase in the number of students achieving advanced or mastery. This resulted in the school's 9^{th} grade math index being raised eight points, from 80 to 88. Significant gains were also seen in the proficiency percentages for the two at-risk subgroups. The percentage of 9th grade African-American students scoring in the proficient range grew from 50 percent to 57 percent and the group of students from low socio-economic backgrounds improved from 51 percent to 60 percent.

We were ecstatic to see the efforts of these teachers and students result in higher iLEAP scores. From the outset of this endeavor, there was no question that we would have a positive impact on the number of students passing the Algebra course in one year instead of two years using Parts I and II. We were less certain of how this endeavor would impact our 9th grade test scores although we remained optimistic about the prospect of tapping these students' potential to reach proficiency in Algebra. While 45 students were originally scheduled for the algebra block, only 33 remained through the testing cycle. The loss of approximately a fourth of these at-risk students serves to demonstrate the volatility surrounding the lives of many of these struggling learners. Of those that completed the course, all but five students met minimum requirements for promotion, three of which were retained due to excessive absenteeism. Predictably, these five students also scored *unsatisfactory* on the 2010 iLEAP administration. We were very disappointed to learn that 13 of the students in the block would receive scores of *unsatisfactory* and an additional 16 students would score *approaching basic.* Of the 33 students that completed the course, only four students demonstrated proficiency with three of these at the *basic* achievement level and one *advanced.* Overall, African-American students experienced an increase in the proficiency percentage, up to 58 percent, while the students from low socio-economic backgrounds saw a decrease of four points to 42 percent.

Clearly, we would like to have seen a much greater demonstration of student success on the standardized tests. However, we recognize that the students selected for the block classes were the lowest performing of those entering the 9th grade. Whereas during the previous year, another tier of at-risk students was included in the cohort, this was not the case in the most recent application of the block schedule. There is little doubt that these numbers were influenced by the decrease in the number of students we were able to serve. Unfortunately, simply adding an additional hour of math instruction was not enough to have a significant influence on the achievement of the remaining at-risk students. In spite of the disappointing test scores, teachers felt that the endeavor was successful in supporting the students' efforts in the math classroom and improving their fundamental math skills.

In designing the block class, we were able to utilize the new seven period schedule that allowed us the flexibility to offer six block sections of Algebra. Through the use of the 90-minute instructional block and the class size limitation of 15, it was believed that teachers would have the opportunity to employ a variety of instructional and assessment strategies to reach these struggling learners in a way that had never been provided to them. Allowing students to have access to the same teacher during both halves of the block was deemed as a must-have in lieu of perhaps designating one teacher to provide instruction and another to serve in the laboratory during independent practice. Addressing independent practice during this time was an important consideration as well. While we hoped that students would become more independent in their learning, it was recognized that most of these students would be lacking in the support mechanisms at home to set our early expectations too high in this area. .

Based upon the 2008 spring administration of the 8th grade LEAP, 138 students lacked proficiency in math but only 90 could be given the additional support available through the algebra block. As it would turn out, not all 138 would enroll at OPHS, but of those who did, the 90 most at-risk of failure were block scheduled for algebra and a letter was sent home to parents indicating the student's placement in the block classes. There was very little feedback from parents although a couple of them did ask that their children not receive this accommodation. For the most part, once the parents were informed of the service and how it related to the student's need, they were supportive of the placement decisions. The placement process was continued in 2009, however, due to personnel cuts and the loss of two teachers in the math department, only three sections of the block could be offered. With the state's adoption of the career diploma tract, one of these sections was absorbed by students who were promoted with unsatisfactory test scores and in need of remedial math credit before being allowed to schedule algebra. These students were also placed in a block section, receiving remedial math during the first semester and algebra during the second. This further limited the number of students that had previously scored at the *approaching basic* level and who could have benefited from participating in the block classes. It goes without saying that we are looking for ways to increase the block offerings to serve additional students in the coming year.

Student achievement has not been easily obtained. The block teachers were forced to rethink how to help students reach a level of success that they had not known for some time. Primary reasons for this failure to achieve can be attributed to a lack of adequate support systems at home/school and the time and energy it would take for a particular student to raise improve their abilities back to grade-level. For many of these students, their childhood has seen only the bare necessities offered at home to assist in academics/nurturing. One of the initial focuses became to give students early opportunities for success and feedback. Several different methods were used to accomplish this, including the use of assessments that addressed smaller chunks of content that were less comprehensive in nature. Emphasis was placed on developing a common vocabulary and students rewarded for correct applications of these vocabulary words. Efforts were also made to give a great deal of feedback such as writing notes on assessments or putting stickers on students' work to affirm their efforts.

The truth concerning the depth of these students' understanding became quickly apparent to the teachers charged with their instruction. To help overcome this, extra time was spent allowing students to read, talk through, and explain problems so that students increased their understanding of objectives, problems, and processes. During lab-time, teachers assigned units from the Plato system that reinforced the lesson taught during the first hour and required students to perform these activities with at least 80 percent accuracy. What teachers found was that students would assist each other on the Plato lessons and even began to compete to determine who could get the most correct and the most sections completed.

Because algebra often has no relevance in their world, keeping students engaged was another priority. One way teachers accomplished this was through the use of small marker boards that students used as an alternate to writing on notebook paper. Student work could be quickly assessed and affirmed and the students felt liberated and were completely engaged in the lesson. Teachers also used *hands-on-equations* where students could physically move game pieces and dice to balance equations. The process created in their minds a picture of what was happening which in turn developed a long-lasting skill that could be transferred to sets of problems on paper.

Students were given graded assignments in groups, which required them to defend or explain why they worked a problem in a certain way. As the teacher monitored progress, if students had nothing to contribute, this was an indicator that no link had been made and students saw no relevance. The teacher would sit in the group and ask guiding questions to help fill in the blanks. Two projects were given, one in each semester, which created a unique opportunity for the students to see their teachers really work at something of which they were not a master and experience how an Algebra skill could be applied in the “real” world. As the teachers gave instructions and then began their own project, students were able to see their teachers do not know everything themselves but were willing to learn and accept help from their students. Students then accepted help from both their peers and teachers, which helped the students to bond together as a group. After the bonding project, students felt more comfortable asking for and offering assistance.

The at-risk students served in the algebra-block seemed to have lives outside of school that lacked factors of consistency and dependability. The teachers diligently tried to provide structure and continuity through daily routines. For instance, *First-Five’s* were on the board at the beginning of the period, to be worked in the notebook, checked, and discussed. This was followed by a lesson and ended with a summation. While presentation of the lesson and the types of assessments were varied in many ways, the routine rarely did so. Students were also afforded with opportunities for movement and were free to get up at anytime during the lesson.

The greatest challenge for most of the teachers was allowing the classroom to evolve into the student’s classroom instead of the teacher’s. Allowing students to have input into how lessons would progress and the best formats for assessment was very difficult. Teachers accepted the idea that each child learned and comprehended at different rates and moved away from the standard of teaching Monday through Thursday and testing on Friday. When tests were given, grades were not final and could be revised at any point the student showed adequate work and desire to test again. While teachers have in no way mastered this concept, they have become very open to allowing this differentiated approach to change the world in which we teach and our mentality that some students are just failures and should be left to do so. However, teachers were unable to motivate all students. These hard-to-reach students would occasionally seem interested and engaged but never fully bought into our efforts. These students did find the group projects appealing, possibly indicating that exercises that are more tactile should be included that would lead to discovery learning. Teachers began to learn more about the personal stories of each of these students as the year progressed and found them to be battling with intense issues and circumstances that made it easy to understand how math, or any other subject, would not rank high on their list of priorities. Unfortunately, several of these students refused to let the teachers, mentors, or counselors help them and never found the academic success that many other students found.

By the end of the year, the students in the block had truly become our children and our investment for the future. Students felt accountable to teachers and teachers to students. As they left school at year's end, most of them left with pride and confidence because teachers had believed in them and showed them how to succeed. It is greatly hoped that through their experiences in the algebra block, students have been given a leg-up and have both the ability and motivation to continue striving for success. We will continue to offer every support possible to ensure that each student who desires success finds it at our school.

Summary:

Use of veteran teachers and a block algebra schedule does not guarantee academic success for at-risk students. It is however, an important departure from the tired and ineffective strategies of the past. There continues to be enthusiasm among those that can make a difference to actually do so for a group of students whose futures may hang in the balance. The increases in student performance on standardized assessments have been encouraging as have increases in the number of students passing algebra in one year. Efforts to improve the service being provided to struggling learners will continue to be made and it is our hope that the achievement gap between the highest and lowest performers will continue to close. The wise use of all available resources and a willingness to think out of the box will be a necessary part of confronting this difficult problem.

Richard Hearn *is currently Curriculum Coordinator at Ouachita Parish High School. He has 17 years of experience at the high school level, all of which have been in diverse settings. Additionally, Richard has worked for at the state level with the Louisiana Department of Education. His education includes the Master of Science in Curriculum and Instruction from Louisiana Tech University and the Doctor of Education in Educational Leadership. He may be contacted at hearn@opsb.net.*

Jeanne Clark *is currently Math Department Head at Ouachita Parish High School. She has 24 years of experience working with diverse student populations at both the high school and middle school levels. Additionally, Jeanne has collaborated with staff from the Louisiana Department of Education on iLEAP and GEE math test item development and has worked to revise math curricula within the Ouachita Parish School District. She may be contacted at jclark@opsb.net.*

.

Teaching Perimeter and Area

Ramakrishnan Menon
Georgia Gwinnett College, Lawrenceville, Georgia

Abstract:
Some difficulties to the teaching and learning of perimeter and area are discussed, and a more conceptual approach that might redress these difficulties is suggested.

According to Clements (1999), "Measurement is one of the principal real-world applications of mathematics. It bridges two critical realms of mathematics: geometry or spatial relations and real numbers. Done well, education in measurement can connect these two realms, each providing conceptual support to the other" (p. 10). Unfortunately, measurement is usually taught without providing such connections and conceptual support. For example, in teaching topics such as perimeter and area, the emphasis is usually on using a set procedure, rule, or formula to compute perimeters and areas of geometric shapes. An additional difficulty is having to grapple with making sense of the algebraic notation used in perimeter and area formulas. In this paper, I discuss a) some drawbacks to teaching perimeter and area in a very procedural manner, and b) some ways to teach these two topics so that learners can make appropriate connections.

THE TRADITIONAL APPROACH

Students are usually taught to "add up all the sides" to get the perimeter. Students are then given the formula $P=2(l+w)$, for the perimeter, P, of a rectangle with sides l and w. Next, rather than being shown that a square is a special case of the rectangle, students are given the formula $P=4w$, for the perimeter, P, of a square with side w. This procedural learning of perimeter leads to some difficulties. Some of these difficulties, as well as suggestions to minimize them, are discussed next.

There is a gap between the practice of "adding up all the sides to get the perimeter" and the generalization, given algebraically, of $P=2(l+w)$. Even if students were shown $P=l+w+l+w=l+l+w+w=2l+2w=2(l+w)$, this presupposes some basic knowledge of simplifying and factoring an algebraic expression. Since students generally have NOT been exposed to algebraic expressions at the stage when the formula for the perimeter of a rectangle is taught, using the formula $P=2(l+w)$, becomes a meaningless manipulation of symbols. (The grade level when this is taught usually varies slightly across different states, but it is generally true that there has been limited exposure to algebraic expressions prior to use of this formula.) Also, because the units of length are not explicitly stated in the formula, there is a tendency for the learner to just put in a number, without associating it with the required unit. Hence, the perimeter becomes associated with a formula and a number, without the connection to the idea of a measure of length, or of the total distance around a given figure.

A SUGGESTED APPROACH TO TEACHING PERIMETER

I have had success with the following approach teaching the perimeter of a rectangle. First, I ask students to look at a 4 ft by 2 ft rectangular ceiling tile. Then, I ask a volunteer to stand right below one vertex of the tile, walk forward in a straight line a distance equal to the estimated distance around the tile, and stop. Most of the first attempts are underestimates, but, after a discussion, students usually correct themselves. They are usually taken aback at how far the distance around the rectangle is, when seen as a straight-line distance. Then I tell them that the distance they would have walked around the rectangle is called the perimeter of the rectangle. Thus, they can visually associate the perimeter with a distance or length. This introduction of perimeter as "the distance walked around a figure," helps students see that perimeter is measured as a unit of length. The concept of perimeter is further strengthened by the physical activity, and the visual connections between the straight-line walk and the distance around the rectangle.

As a modification of this task, I have asked young children to estimate what is longer: a length of string that goes around the perimeter of their rectangular box file, or a length of string that stretches straight down from their heads to their toes? Most of the time, they have underestimated the perimeter, and are surprised at how close the perimeter is to their heights.

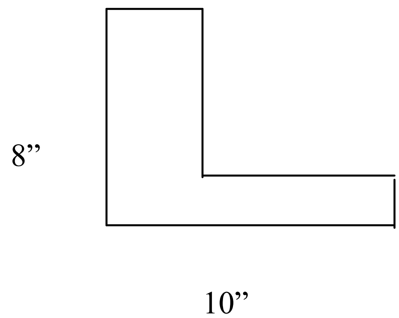
Just adding the sides gives little meaning to the concept of perimeter as a measure of length. It would be better to start by saying, “How far (inches, feet, etc) would you have walked, if you started at one point of the figure, and walked all around it, until you get back to your starting point?” This could be followed up with rearranging that distance obtained in a straight line or other geometric shapes, as explained next.

For example, using a rectangular box, the teacher can demonstrate at least two ways of getting the perimeter of one of the rectangular faces. One way would be to tie a piece of string once around the box, so that the string traces the perimeter of the associated rectangular face. Next, unfold the string and lay it in a straight line to measure its length. Another way would be to put strips of paper/drinking straws around each of the four edges of one of the rectangular faces, and rearrange the strips/straws, “head to toe,” in a straight line, and measure the total length of the strips/straws.

A FURTHER DIFFICULTY

Another problem that has surfaced with the “add all sides” rule, and the practice exercises in which all the measures of the sides are indicated, is the lack of analysis and synthesis of appropriate relationships. For example, about 25% of preservice teachers asked to find the perimeter of an L-shaped figure (Fig. 1) believed there was insufficient information given

(Menon, 1998). These preservice teachers did not realize that the perimeter of the L-shaped figure would be the same as that of a related rectangle with the given dimensions (Fig. 2).



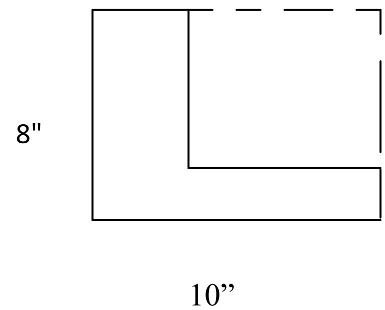


Fig. 1. Sufficient information to find perimeter? Fig. 2. Related rectangle

As an extension, I have asked students whether it is shorter to go down/southwards and then right/eastwards along a parking lot (along the two long arrows), or to follow a “step-like” path (along the short arrows), weaving in between the parked cars (Fig. 3). Many of the students do not see that both distances would be the same.

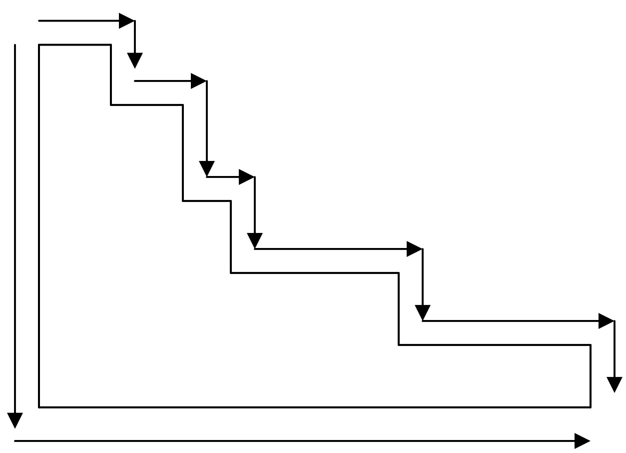


Fig. 3. Which is shorter distance?

PERIMETER WORD PROBLEMS

When giving problems involving perimeter of a rectangle, the most common ones are like those given next. If the perimeter of a rectangle is 20” and the length of the rectangle is 7”, what is its width? The usual way is to substitute in the formula $P=2(l+w)$, and solve for w. Such a solution again presupposes familiarity with algebra, specifically, linear equations with one unknown.

A more conceptual approach would be to explore the relationship between the semi-perimeter, $P/2$ or $l+w$, and the linear dimensions of the rectangle. Since a perimeter of 20" implies a semi-perimeter of 10", this question reduces to finding the missing addend in a pair of numbers whose sum is 10, where one of the addends is 7. Hence, the missing addend, the width, is 3".

This sort of problem can be generalized to the part-part-whole situation, where we know a part and a whole, and we are required to find the other part. Assuming that the part-part-whole approach is familiar to the students (they would have come across this as early as in Grade 1), students can be empowered to construct their own perimeter-related problems of this type. Student-generated problems have been shown to have many benefits (Brown and Walter 1993; English 1999; Menon, 1996), most of which are closely associated with a constructivist approach. In this case, constructing such problems necessitates a strong grasp of the relationships between the edges of a rectangle, and the perimeter.

DIFFICULTIES WITH THE TRADITIONAL TEACHING OF AREA

In teaching the concept of area, it is common to state that the area of a rectangle is found by multiplying length times width, generally shortened to "*Area = length x width,*" even if the formula ($A=lw$) were not stated explicitly in algebraic terms. Students are then introduced to the area of a triangle as "*Area= ½ base x height*," usually after a demonstration of the triangle formed by drawing one of the diagonals of a rectangle.

Teachers need to spend more time explaining how the length and width of a rectangle suddenly become the base and height, respectively, of the triangle. Without such explanations, children tend to multiply the adjacent sides (dimensions) of a parallelogram and state, incorrectly, that this product gives the area of the parallelogram. Such a conclusion is an example of negative transfer of learning, from the previously learned "*Area= length x width,*" for the area of a rectangle. Such conclusions stem from passive learning and teacher-centered pedagogy, rather than the active learning supported by constructivist pedagogy. Additionally, the mathematical concept and meaning of area, and associated terminology (for example "height") are inaccurately perceived.

The matter becomes progressively worse, when children are faced with obtuse-angled triangles, for now there is the added difficulty of reconciling the height of a triangle as lying "outside" the triangle. Intuitively and perceptually, students feel that the height, being outside the triangle, should not be counted as part of the triangle, or for the computation of its area.

A SUGGESTED APPROACH TO TEACHING AREA

Most of these difficulties stem from a procedural approach to the teaching of area, and attempts have been made, with a reasonable degree of success, to avoid a purely procedural approach by using manipulatives (e.g. McDuffie & Eve, 2009) and problem solving approaches (e.g. Mihaila & Barger, 2008). I suggest that children could be guided to progress from manipulatives through inductive reasoning to the relationship "*Area= length x width,*" using a series of rectangles of given dimensions, with grid lines showing the number of squares in each row and column. Such an approach promotes the concept of area as how much space is covered, and the formula becomes a more efficient way of counting the total number of squares enclosed in the rectangle.

In addition to this approach, teachers could profitably spend time discussing the terminology associated with areas of rectangles, triangles, and parallelograms. For example, teachers could help children see that the terms length, width, height, base, etc., are used in a relative, rather than an absolute sense. In other words, if one side is designated the base, the corresponding perpendicular distance to this base becomes the height, and if another side is designated the base, the height changes accordingly.

I have found it useful to ask students whether they are "long" when they lie down, "tall" when they stand up, or whether their "heights" become their "lengths" when they lie down! Additionally, exploring the meaning of "height," of a triangle, as the perpendicular or shortest distance from a vertex to the opposite side, seems to diminish difficulties associated with the height of an obtuse-angled triangle.

To relate the area of a triangle to that of a rectangle, the triangle can be transformed into an associated rectangle whose area can be easily found. For example (Fig. 4), drawing a line joining the midpoints of two sides of a triangle, parallel to the third side, and then folding the small triangles as shown, will result in a rectangle with the same area as the original triangle. Such a result could initially be shown to be true by actually cutting or folding the relevant parts of the original triangle to form the associated rectangle. After this "practical" demonstration/activity, students could be led to deduce this result for this type of triangle, along the lines of the discussion that follows, after which they could be led to generalize this result for ANY triangle (beginning with practical cutting and folding activities with other types of triangles, such as obtuse angled triangles, and then going on to deducing this result for any such triangle). The height if the rectangle is the same as that of the original triangle, but the base of the rectangle is half the base of the original triangle. Hence, the area of the rectangle, and therefore that of the original triangle, would be ½ base (of original triangle) x height. Such transformations not only aid concept building through relationships, but also are a precursor to isometries, and enhance spatial or geometric thinking. A caveat: for practical purposes, since the line segment joining the midpoints was ***stated*** as drawn parallel, the folding/cutting activity would give a reasonable notion of the conservation of area (from that of a triangle to that of an associated rectangle). However, it should be pointed out (and perhaps even proved, depending on our lesson objective and on the grade level of the students) that such a line segment would ***always*** be parallel to the third side, especially if we want students to use deductive logic for generalizations.

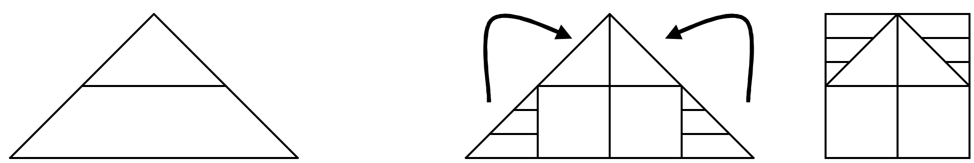


Fig. 4. Transforming triangle to rectangle of equal area

Menon (1998) showed that about 28% of his preservice teachers believed there was insufficient information to decide whether the area of two shaded triangles in a given rectangle could be expressed as a fraction of that rectangle, just because no dimensions were given for the rectangles (Fig. 5). Because these preservice teachers relied on an area formula that depended on the dimensions being explicitly indicated, they did not use transformations to define the relationships between the areas of the triangles and the rectangle, and obtain the necessary fraction, ½.

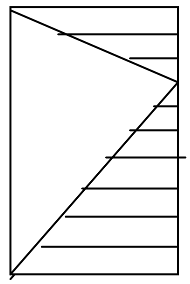


Fig. 5. Area of shaded part as a fraction of area of rectangle

Preservice and inservice teachers were asked to find the area of a square with a diagonal of length 10" (Fig. 6). Generally, they assumed the length of a side as *x* and then used Pythagoras' theorem to arrive at $x^2 + x^2 = 10^2$, $2x^2 = 100$, $x^2 = 50$.

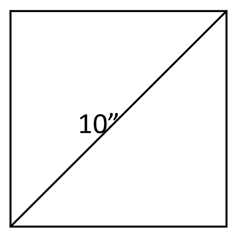


Fig. 6. Area of square with diagonal 10''

If we impose the constraint that the area is to be computed WITHOUT using Pythagoras' theorem, then the students are more likely to look for related figures and properties, rather than an algebraic solution. Combining the property that diagonals of a square bisect at right angles with the knowledge that the area of a triangle is half the product of the base and its height, would then lead to 25 sq in (½ x 10 in x 5 in) as the area of the associated triangle, or half the square (Fig. 7). Doubling 25 sq in would then give 50 sq in as the area of the square. Alternatively, the square could be transformed into a triangle with the same area (Fig. 8), or even to a related square of side 10" (Fig. 9), whose area is double that of the original square.

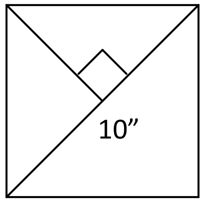


Fig. 7. Finding area

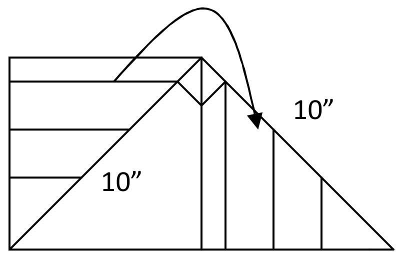


Fig. 8. Related triangle

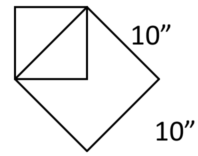


Fig. 9. Related square

DISTINGUISHING BETWEEN PERIMETER AND AREA

According to Moyer (2001), if perimeter and area are learned as a set of procedures, students cannot distinguish that these two measures are distinct, and that “one is the number of length units that fits around the figure, and the other is the number of square units enclosed by the figure” (Moyer, 2001, p. 53). She further states “Students are unable to distinguish between perimeter and area formulas because they have not clearly discerned what attribute each formula measures” (Moyer, 2001, p. 55). The perimeter and area formulas for rectangles both make use of length and width (usually measured in the same units, inches). The students know that they have to use the length and the width in the formulas, but get confused whether to answer in “inches” or “square inches.”

To overcome students’ confusion between perimeter and area, Moyer (2001) relates how a teacher used four irregularly shaped polygons and measured their perimeters and areas. Extending this idea, I suggest we emphasize perimeter and area concepts using irregularly shaped polygons, such as E-shaped figures, H-shaped figures, U-shaped figures, etc, rather than rectangles. For example, consider the H-shaped polygon (Figure 10). By using actual tiles to build these shapes, we can find that the perimeter is 16” and the area is 7 sq ins.

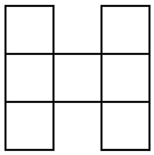


Fig. 10. Area and perimeter of H-shaped figure

Because measurement activities, and not formulas, are initially used to find the perimeter and area for such polygons, there seems to be less confusion between the concepts of perimeter and area. The focus on the two distinct physical processes (measuring around the figure for the perimeter, and counting the squares for the area) seems to help students distinguish between perimeter and area.

As an extension, students could be asked to find the perimeters and areas of composite figures (beginning with figures made up of a triangle and a square, and going on to figures such as a 400 meter running track comprising parts of a rectangle and circle, etc.)

Another confusion between perimeter and area is the perception that if the perimeters have the same numerical value, then the areas must also have identical numerical values, and vice versa. To overcome this confusion, students can be given activities/exercises on figures that have the same perimeter, but different areas, and vice versa. For example, students can be asked to find rectangles having the same perimeter 36", but having different areas. Students could also be asked to find different figures (not necessarily rectangles) having the same perimeter, but having different areas. Similar activities/exercises could be given, where the area is kept constant, but the perimeter varies, as well as those discussed by Ma (1999).

Such activities will help connect numerical values, measurement units, geometric figures, and mathematical reasoning.

CONCLUDING REMARKS

The procedural learning of perimeter and area leads to superficial learning, misconceptions, and difficulties, some of which have been identified in this paper. It has been suggested here that these topics lend themselves readily to hands-on, motivating, and challenging activities. Such activities allow students to explore ways to enhance conceptual learning of these topics, and make strong connections among geometry, measurement, real numbers, algebra, and real-world applications. Emphasizing connections is also in keeping with the vision of math teaching and learning as stated in the *Principles and Standards for School Mathematics* (NCTM, 2000). It is hoped that the successful approaches that have been shared in this paper will complement the teachers' own ideas of teaching perimeter and area, and help facilitate students' understanding of perimeter and area.

REFERENCES

Brown, S. I., and Walter, M. I. (Eds.). (1993). *Problem Posing: Reflections and Applications*. Hillsdale, N.J.: Lawrence Erlbaum Associates.

Clements, D. H. (January, 1999). Teaching Length Measurement: Research Challenges. *School Science and Mathematics,* 99(1), 5-11.

English, L. D. (1999). Reasoning by Analogy. In L. V. Stiff and F. R. Curcio (Eds.), *Developing Mathematical Reasoning in Grades K-12*, (pp. 22-36). Reston, Va.: National Council of Teachers of Mathematics.

Ma, L. (1999). *Knowing and teaching mathematics*. Mahwah, N.J.: Lawrence Erlbaum Associates.

McDuffie, A.R., & Eve, N. (August 2009). Break the area boundaries: reflect and discuss. *Teaching Children Mathematics,* 16(1), 18-27.

Menon, R. (May 1996). Mathematical Communication through Student-constructed Questions. *Teaching Children Mathematics,* 2(9), 530-32.

Menon, R. (November 1998). Preservice Teachers' Understanding of Perimeter and Area. *School Science and Mathematics,* 98(7), 361-68.

Mihaila, I., & Barger, E. (December 2008). Area by dissection. *Mathematics Teacher,* 102(5), 350-355.

Moyer, P. S. (September 2001). Using Representations to Explore Perimeter and Area. *Teaching Children Mathematics,* 8(1), 52-59.

National Council of Teachers of Mathematics (2000). *Principles and Standards for School Mathematics*. Reston, Va.: National Council of Teachers of Mathematics.

Ramakrishnan Menon *(rmenon@ggc.edu) is Professor of Mathematics Education at Georgia Gwinnett College, Lawrenceville, Georgia. He has been involved in teacher education in various countries for about 30 years.*

Guest Column

Notes from Dr. Guillermo Ferreyra – Chief Officer of Louisiana STEM Goal Office

The Louisiana Department of Education has reorganized its divisions to reflect a change in mission from a regulatory agency to a capacity-building mission. Nine Critical Goals covering expectations for student achievement have been assigned to three Goal Offices by content areas: Literacy, STEM (Science, Technology, Engineering, and Mathematics), and College & Career Readiness. These three student centered goal offices sit at the top of the organization; staff members are directly responsible for designing and implementing ways to achieve the critical goals in student achievement. Dr. Guillermo Ferreyra is the first person serving as Chief Officer of the STEM Goal Office. He is responsible for advancing the Louisiana goals for improvement in PreK-12 education in the STEM areas.

Dr. Ferreyra obtained his undergraduate degree in mathematics in Argentina and a Ph.D. in mathematics at Rutgers University. He has served in the Department of Mathematics at LSU as Assistant Professor, Associate Professor, and Full Professor since 1983. His areas of research are in Deterministic and Stochastic Control Theory and Applications to Engineering, Finance, and Economics. He served as Chair of the Department of Mathematics for four years and as Dean of the LSU College of Arts and Sciences for five and a half years.

The immediate goals for the STEM office are to devise processes to improve student achievement in STEM areas. These processes include the analysis of student achievement data to identify weaknesses and opportunities for improvement, the identification and dissemination of best practices, the introduction of new pedagogies including computer assisted assessment and learning, and the provision of focused professional development for in service teachers. Another important task of the STEM Goal Office is the planning and execution of the transition from the Louisiana GLEs and Louisiana Comprehensive Curriculum to the new Common Core State Standards. Longer term goals include the development of partnerships with institutions of higher education, STEM focused industries, and prestigious STEM intensive institutes, and research centers.

STEM Goal Office Services to Districts

1. The STEM Goal Office has been tasked with the primary goal of increasing student achievement in eighth grade math. (The Department is studying how to set additional STEM goals.) The State has a high stakes eighth grade LEAP test which measures student achievement at the end of middle school. Improvement in statewide math scores in this grade has been VERY slow in the last three years. To spark improvements in math in the eighth grade we have designed a comprehensive program which we call **High School Readiness Program**. We plan to offer workshops in each of the eight regions of the State in the next two years to train almost all the eighth grade teachers in the state. We have sent information about this program to each superintendent's office in the State and we have also discussed it several times at the Monthly Superintendents Conference Calls and at the recent Superintendents Summit. These workshops train eighth grade teachers on ALL of the content of the course following Louisiana's GLE's and in a new methodology of teaching involving substantial computer lab time where students are guided with their learning and their homework. The software provides a comprehensive learning and assessment tool with online book materials, solved problems, videos of lectures, etc. The teachers participating in the workshop meet four days within a time span of two months. Teachers submit homework online during these two months.

Our first workshop was offered in the New Orleans area and began Oct 21. Registration is through Coursewhere (https://www.solutionwhere.com/ldoe/cw/main.asp). Additional information is provided in the Coursewhere registration page. The second workshop will begin on Monday and Tuesday of Mardi Gras Break in Shreveport. We are planning two additional workshops for summer in two other regions (yet to be determined) of the State.

2. We also provide information on state and national STEM programs, grants and teaching resources to districts and teachers via email. Teachers interested in this type of **STEM information** can submit their email address to Jean May-Bret at jean.may-brett@la.gov.

3. We provide funding for professional development on a competitive basis through a federal program called **Math and Science Partnerships (MSP)**. We send the call for proposals to district offices once per year. This program funds math and science professional development tailored by districts in partnerships with institutions of higher education.

4. The **LASIP grants** are the other vehicle for funding professional development. This program is administered by the Board of Regents but we participate in setting the content goals of the program. The deadline for submitting proposals for the next (yearly) cycle was November 9. Information about LaSIP can be found at http://www.lasip.org. LaSIP grants involve partnerships between a district and an institution of higher education. The grant provides for the salary of the university professor(s) and the stipends of the teacher participants during part of the summer. It is time to start planning for next year.

5. Our office also runs a program of professional development for math in grades 3-5 called **Ensuring Numeracy for All (ENFA).** Twenty four elementary schools received awards on a competitive basis two years ago for this program. Unfortunately, we have not been able to make awards to additional schools due to budget constraints. We are reorganizing this program to broaden its reach to middle school math.

For additional information, please contact our office.

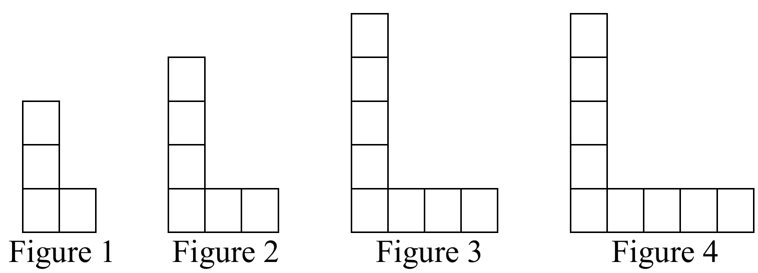
Guillermo Ferreyra, Ph.D. (Guillermo.Ferreyra@la.gov)
Chief, STEM Goal Office
Louisiana Department of Education
(225) 342-3411

Preservice Point of View: Creating a General Rule for a Pattern

by Nell McAnelly and DesLey Plaisance

This section of the *LATM Journal* is designed to link teachers and future teachers. In each journal, responses to a mathematical task by preservice teachers are presented. It is anticipated that these responses will provide insight into understanding, reveal possible misconceptions, and suggest implications for improved instruction. In addition, it is expected that this section will initiate a dialogue on concept development that will better prepare future teachers and reinforce the practices of current teachers.

Preservice elementary education students enrolled in a senior-level mathematics course specifically designed for elementary education majors and focused on algebraic reasoning were given the following sequence of figures:



The students were asked to describe the pattern in terms of the diagrams and to write a general rule for building any figure in the sequence.

When developing a rule for a pattern, it has been observed that many preservice teachers immediately revert to the number of tiles in each figure (4, 6, 8, 10 … in this example) to seek a formula representation for the rule. The problem specifically stated "in terms of the diagrams" to emphasize the connections from the development of patterns in elementary school to the generation of arithmetic sequences in more advanced study.

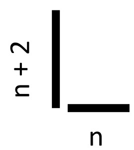
As students analyze patterns, one method used of predicting the next term is to relate the upcoming term to the current term. In the given problem, one might say that two additional tiles are added to a particular figure to get the next figure. Such a rule where each succeeding term follows from one or more of the previous terms is recursive in nature. Unless the rule is generalized, one must compute all previous terms to find any subsequent term. In contrast, a generalized formula allows direct computation of any term (typically referred to as the "n^{th}" term) in the sequence. This generalized form is sometimes called the "closed rule" or "explicit rule" and may be explained in words or given in an equation format.

The problem was given on the second day of class without prior instruction on the concepts. Thirty-two pre-service teachers participated. All students gave some description based on the diagram and five different basic views of the mathematical structures emerged. Fifteen of the participants used only recursive rule descriptions, six students gave explicit rules, and eleven students gave explanations with both types of rules. Note that almost half of the students used solely the iterative process. This process to determine any term in the sequence would be quite lengthy as the number of terms in the sequence increased. One might question why so many students selected the iterative process. Do students understand what is meant when asked for a general rule? Is this what they were taught earlier about patterns when asked to give a generalized rule for finding any term? Are students able to make connections between diagrams/formulas and pictures/sequences?

Sample solutions are provided. As these solutions are examined, one can see that some solutions are more "sophisticated" than others. In looking at the incorrect or incomplete problem solutions, teachers of preservice teachers may use these errors to facilitate a discussion of making connections from the figures and position in the sequence to the description of the pattern to the formalized general rule.

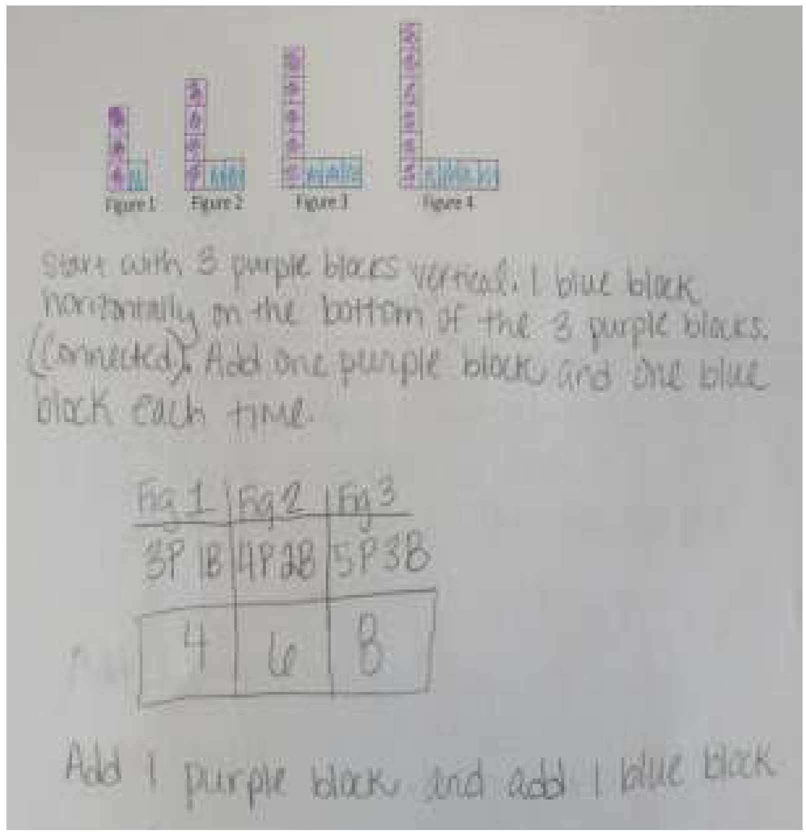
In each of the provided student samples, the student notes include an explicit rule for each different structure based on the student work and using “n” as the term (figure) number and F(n) as the number of tiles in the figure.

Basic Structure 1:

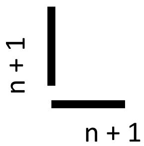


$F(n) = (n+2) + (n)$
$\quad\;\; = 2n + 2$

This student observes vertical and horizontal components but does not connect a figure to its position in the sequence (term number or figure number). The rule is more recursive in nature by stating to add one more purple and one more blue each time.

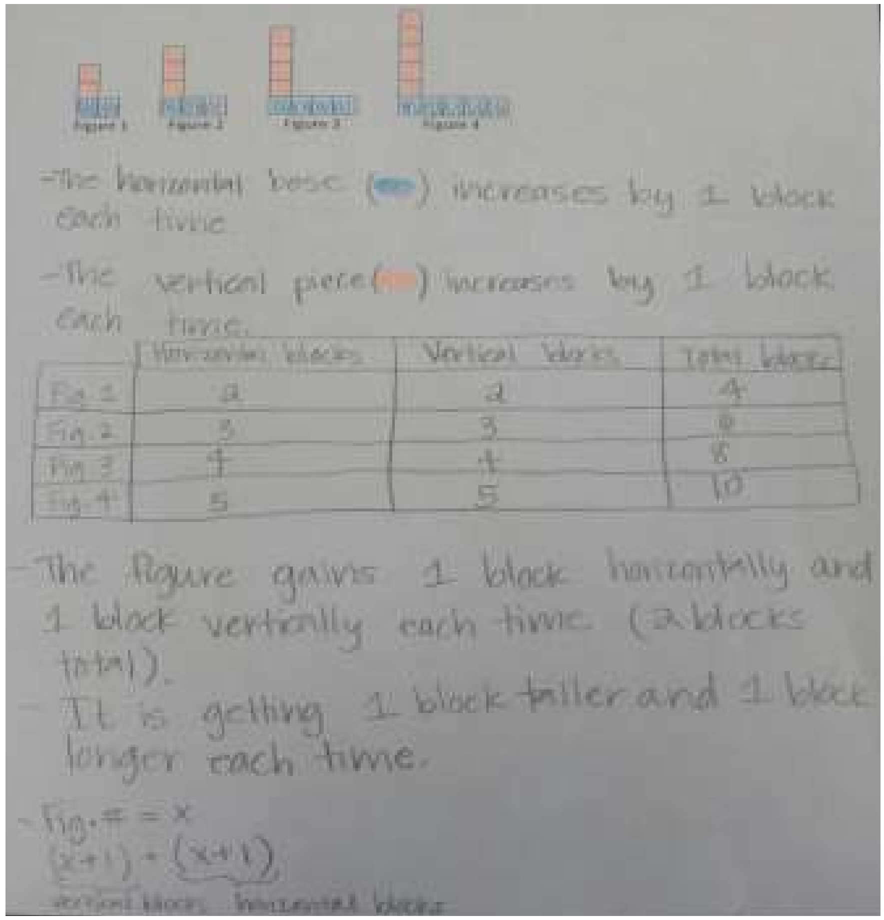


Basic Structure 2:

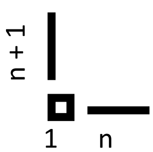


F(n) = (n+1) + (n+1)
= 2n +2

Basic Structure 2 is very similar to Basic Structure 1. The difference is that the corner tile is placed with the horizontal component as opposed to the vertical component in Basic Structure 1. That corner tile's grouping creates a slightly different development of the rules. This student finds both the recursive and the explicit rules.

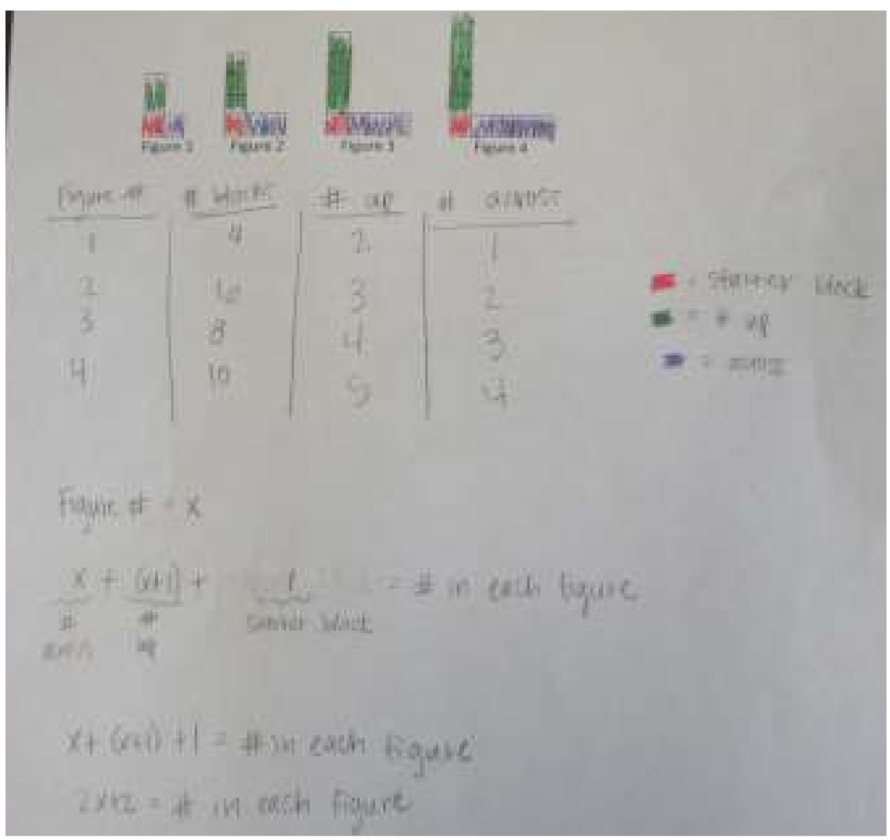


Basic Structure 3:

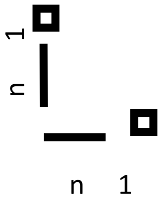


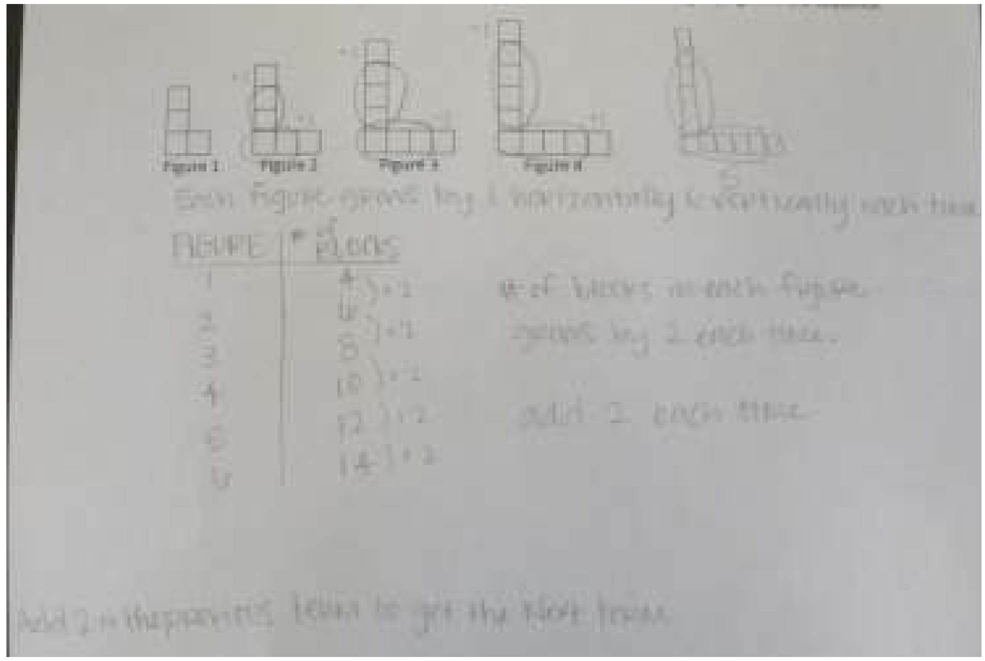
F(n) = (n+1) + (1) + (n)
= 2n + 2

All parts of the description are clearly identified and connected to the diagram for developing an explicit rule.



Basic Structure 4:

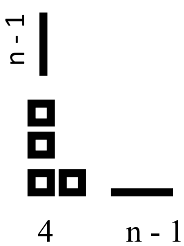


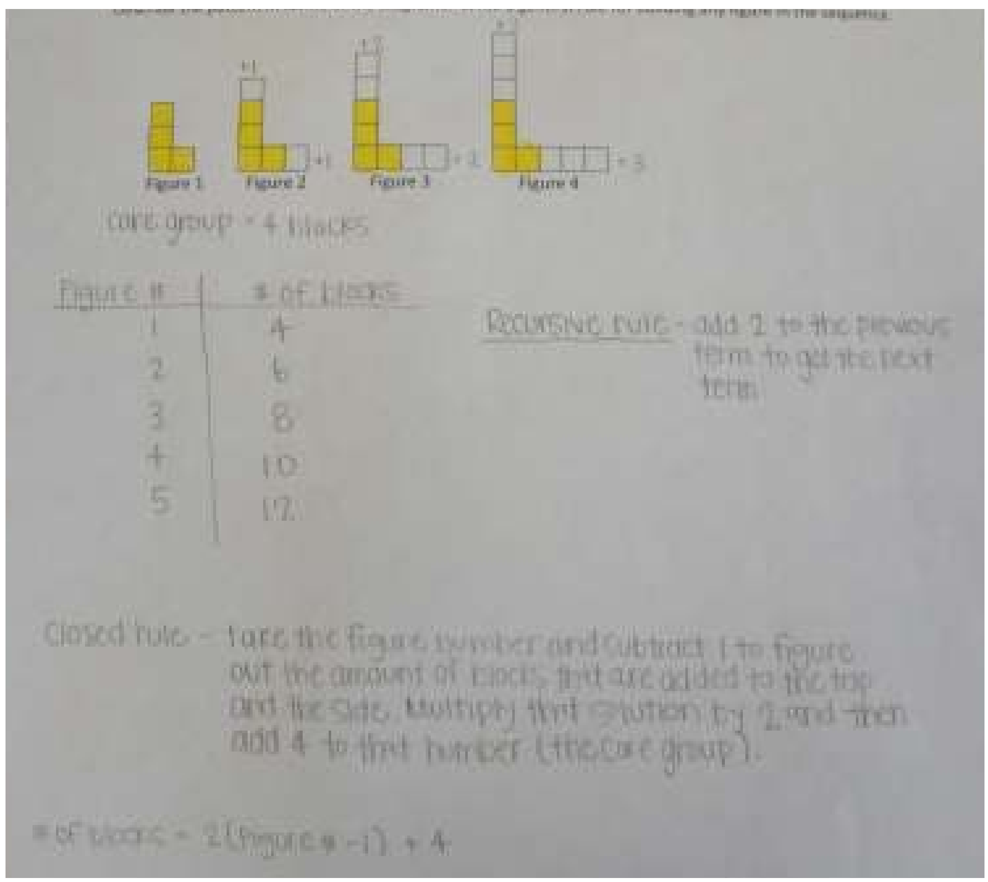


$F(n) = (1) + (n) + (n) + (1)$
$= 2n + 2$

The diagram is labeled in a manner conducive to developing an explicit rule. However, as in the example for the first structure above, the student has not made the connection from the tiles circled in the diagram to the term numbers.

Basic Structure 5:





$F(n) = (n - 1) + (4) + (n - 1)$
$= 2n + 2$

There is a clear explanation of both the recursive rule and the explicit rule. The explicit (closed) rule is given in both a word description and a formula format. The figures are also connected to an input/output table.

Dr. DesLey Plaisance *is currently an Assistant Professor in the Department of Mathematics and Computer Science at Nicholls State University and serves as Coordinator of Graduate Studies in Mathematics. She teaches undergraduate courses in mathematics for education majors and graduate courses in mathematics curriculum/research. Plaisance's primary research focus is mathematics anxiety of preservice elementary teachers. She is the LATM Journal Coordinator of the LATM Executive Council.*

Mrs. Nell McAnelly *is Co-Director of the Gordon A. Cain Center for Scientific, Mathematical, Engineering, and Technology Literacy and is a mathematics instructor at LSU-BR. Her most recent teaching focuses on mathematics content courses for elementary education majors. McAnelly oversees numerous professional development projects for mathematics and science teachers from kindergarten through twelfth grade and is the Executive Director of the Quality Science and Math Grant Program. She presently serves on the LATM Executive Council as Treasurer.*

Tech Talk

Delicious:
Not Always Used to Describe Food

Lori C. Soule

What is more frustrating than locating a great website on math simulations while surfing on the weekend and not remembering the URL when you get to school on Monday? Or, maybe you accidently locate a website that contains many math reference sheets (algebra, geometry, trigonometry, and calculus), you forget to bookmark the site, and you can't find the website in your history file at a later date.

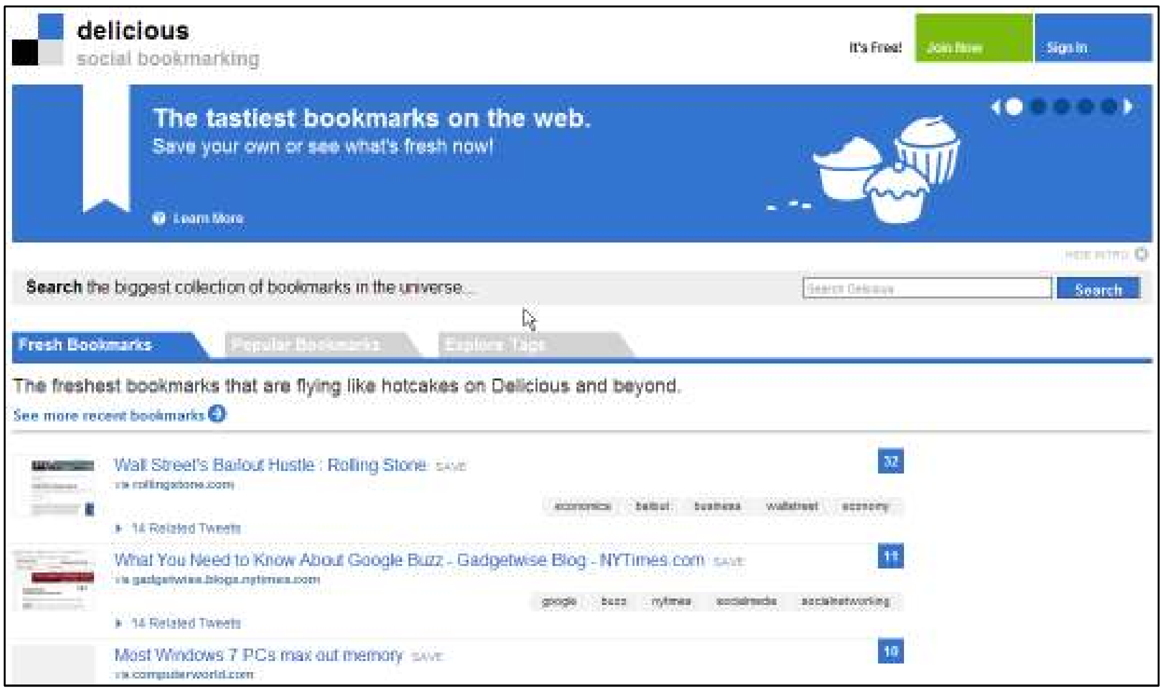
There is a simple, quick remedy for this problem—social bookmarking. Social bookmarking is "method for Internet users to share, organize, search, and manage bookmarks of web resources. Unlike file sharing, the *resources* themselves aren't shared, merely bookmarks that *reference* them" (Wikipedia, 2010). As resources are located, they can be "tagged" for future reference. A tag is a keyword or term associated with or assigned to resource (article, picture, video clip), thus describing the resource and enabling keyword classification of the information. Because social bookmarking is Internet based, users can access their bookmarks whereever and whenever they have Internet access, including through of the use of smart phones.

Another advantage is that bookmarks can be shared. You can send bookmarks to a person's e-mail address and they can do the same for you. You can subscribe to other people's bookmarks or you can join someone's network.

There are several social bookmarking sites including Digg, Ma.gnolia, delicious, diigo, and Furl. Other social bookmarking sites include uticked, a social bookmarking site for teachers, and citeulike, a social bookmarking site for academic papers. For my Tech Talk today, I'll be taking a look at delicious.

Getting starting with delicious is very easy. The URL for the delicious site is http://delicious.com/. At the top of the webpage, the "Join Now" button is very obvious. The homepage for delicious is displayed in Figure 1. Because delicious is a Yahoo

Figure 1. delicious home page



company, you can use your existing Yahoo! ID information to create your delicious account or if you don't have a Yahoo! ID, you can easily create one. Figure 2 displays the sign-in screen you will use if you have an existing Yahoo! ID while Figure 3 displays the screen that you will use to create a Yahoo! ID.

Figure 2. Yahoo sign-in screen.

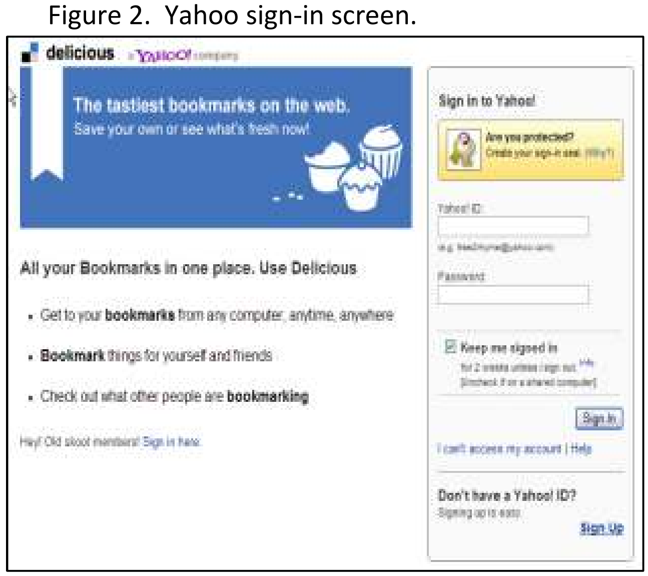
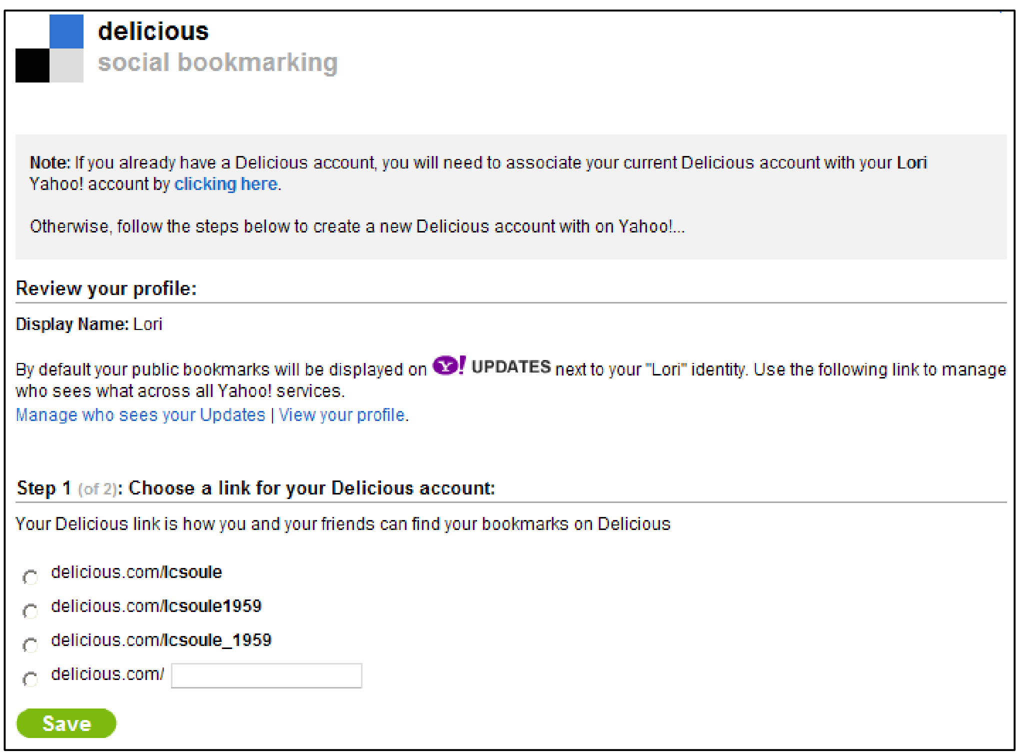


Figure 3. Create a Yahoo! ID account

Upon signing-in with your Yahoo! ID, or after you create a Yahoo! ID, you will be asked to choose a link for your delicious account. As you can see at the bottom for Figure 4, you can choose one of the pre-determined links or you can create one yourself.

Figure 4. Choosing a delicious account link



After choosing your delicious account link, you will be given the opportunity to add bookmarks to your browser. Finally, you will be brought to your delicious page. Being new to delicious you will have no bookmarks; however, you can import your bookmarks (or favorites) that are in your browser. Figure 5 displays what a new user to delicious will see upon the creation of their account.

Figure 5. My delicious homepage

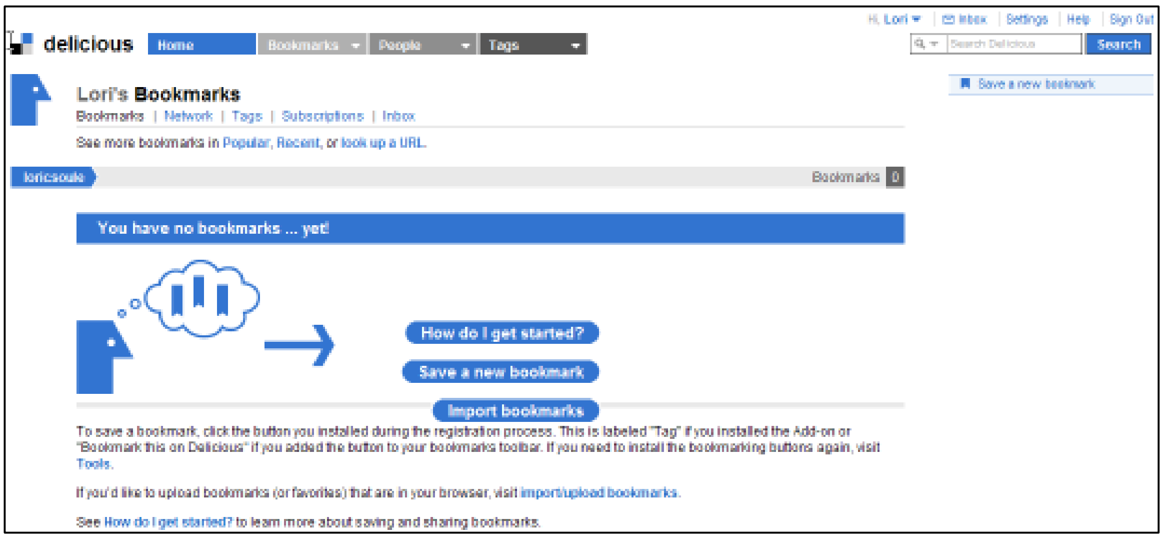
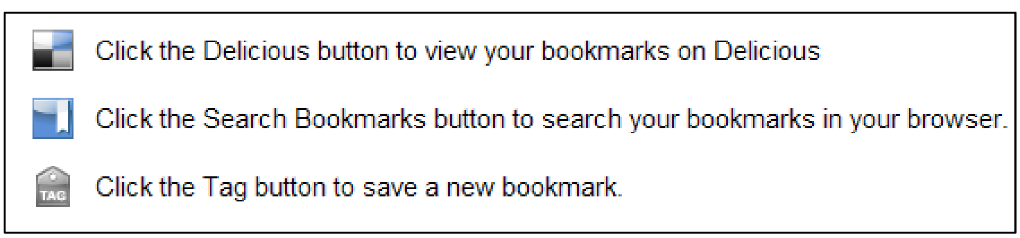


Figure 6 displays the three basic buttons that you will be using:

Figure 6. delicious buttons



Saving a bookmark is easy and you will find that tags and notes will make your bookmarks easier to manage. Depending on what buttons you've added to your browser, you can "Tag" or "Bookmark this on Delicious" by simply clicking on the button to save a new bookmark. In the pop-up window that opens as shown in Figure 7, you will be given the opportunity to enter information about the webpage you are bookmarking. You can also send this bookmark to someone in your delicious network, share this bookmark on Twitter, or e-mail this bookmark to friends. Table 1 presents a list of fields and their definitions used when entering a bookmark.

Figure 7. Entering bookmark info

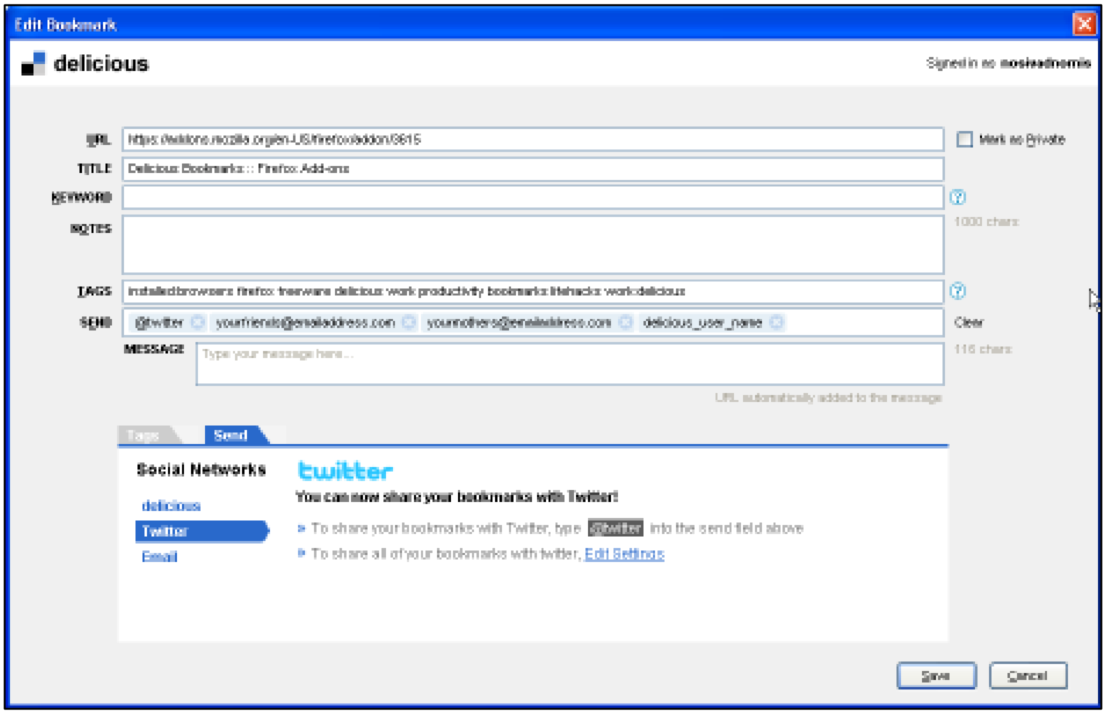
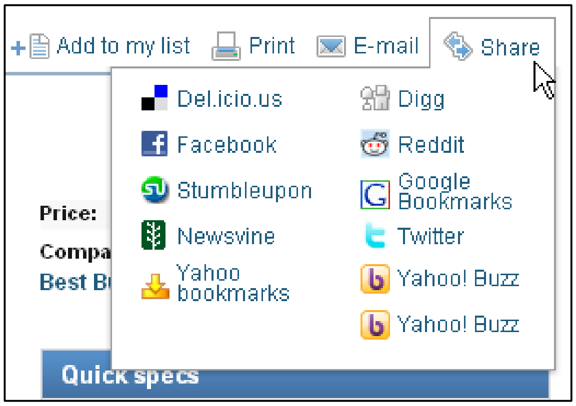


Table 1. Bookmark fields and definitions

Field	Definition
URL	The URL field is simply the address of the page you're bookmarking; this should be filled out for you.
Title	If you're using one of our bookmarking tools, this will be prefilled with the title of the page you're saving. Feel free to edit this in any way that makes sense to you.
Notes	Here's where you may want to write some additional info for yourself or to let others know why you bookmarked this page.
Tags	Enter one or more tags separated by spaces here. They are optional, but by using them, they make your bookmarks much easier to organize and navigate.
Send	People and places you want to share your Bookmark with. This could be the social network Twitter, an email address, or a Delicious user.
Message	A message that will appear with your Tweet, Email, or Delicious message. Limited to 116 characters. (delicious)

Figure 8. Bookmarking



Once you start using delicious, your network will grow along with the number of tags you are using to describe the bookmarks. Another thing you will begin to notice is that as you visit different web pages and read various articles, most of them have a link included on the page which allows you to bookmark the web page on various social bookmarking services. An example of what you make see while visiting a webpage is shown in Figure 8. When the delicious link is clicked, you will be transferred to another tab in your browser or to a pop-up window where you can then enter in the tags to describe the page, along with other information about the page. Upon completion, click the Save button. Your bookmark will be added to your delicious page.

After using delicious for a while, your link homepage will become filled with bookmarks and tags. You will see a listing of your most frequently used tags along with a list of all of your tags. You can change the page to view all of the members of your network, whether you or not you are part of their network, and a listing of recent network bookmarks. In addition, you can view a word cloud view of all of your tags. Figures 9, 10, and 11 display the different views of your account.

Figure 9. Home view

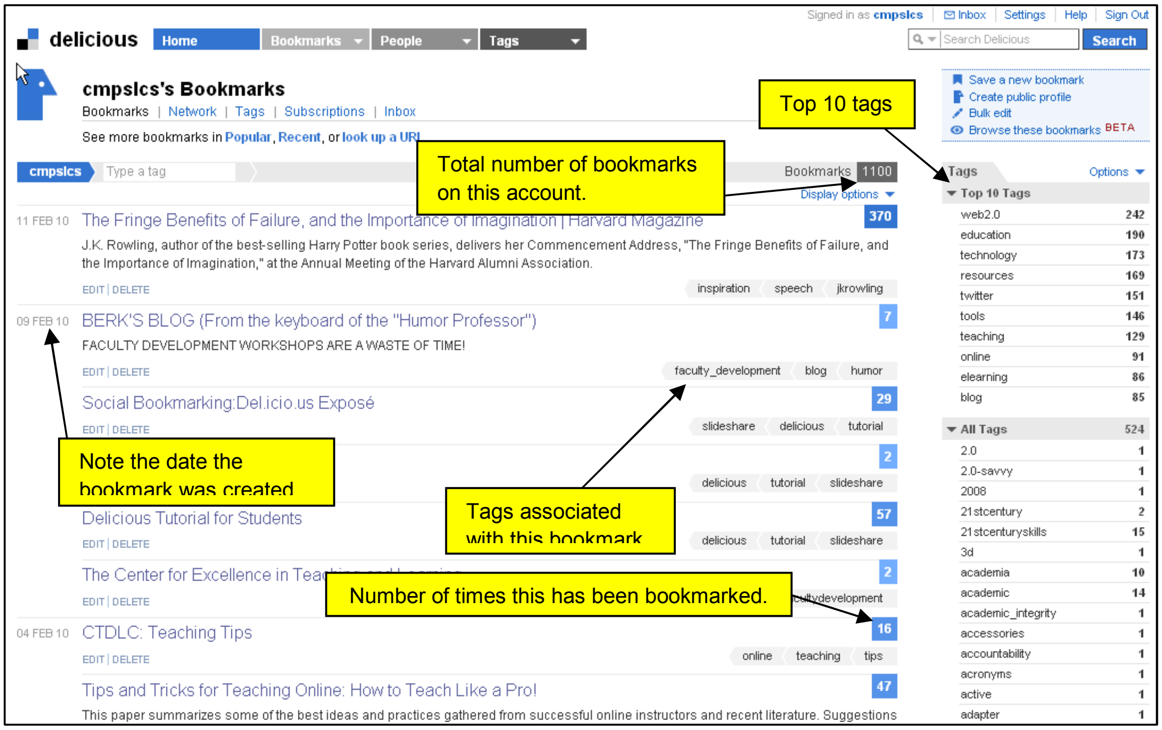


Figure 10. People in my network

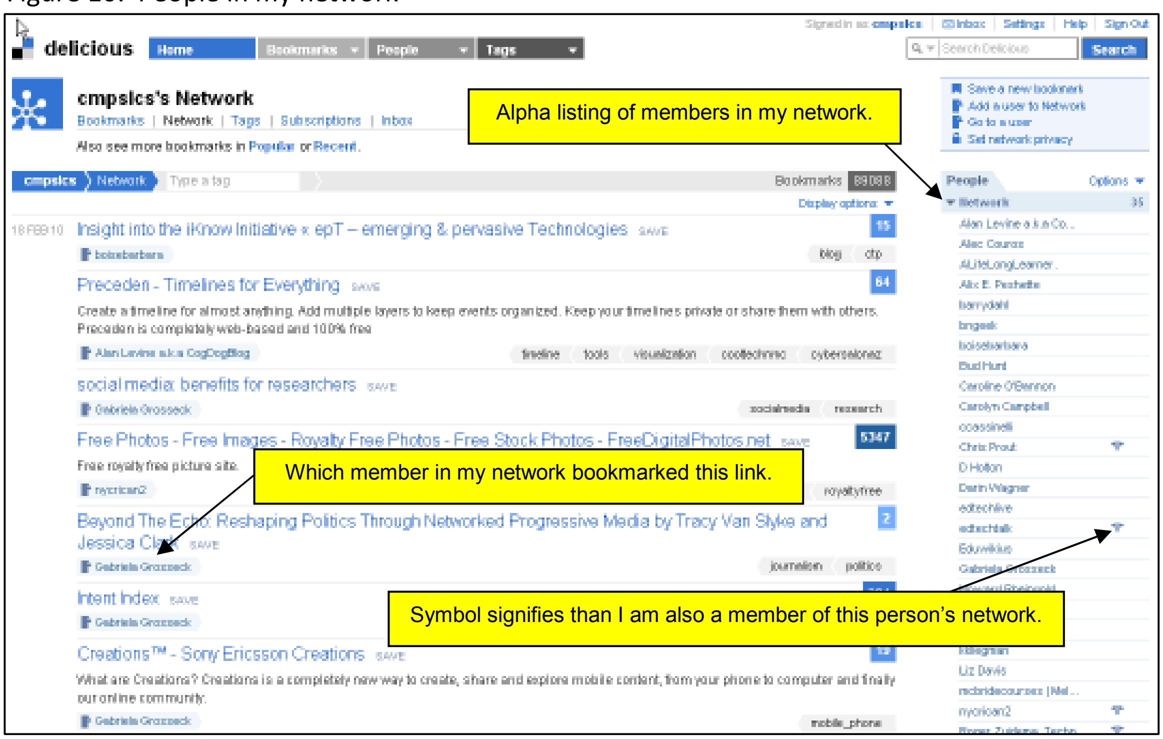
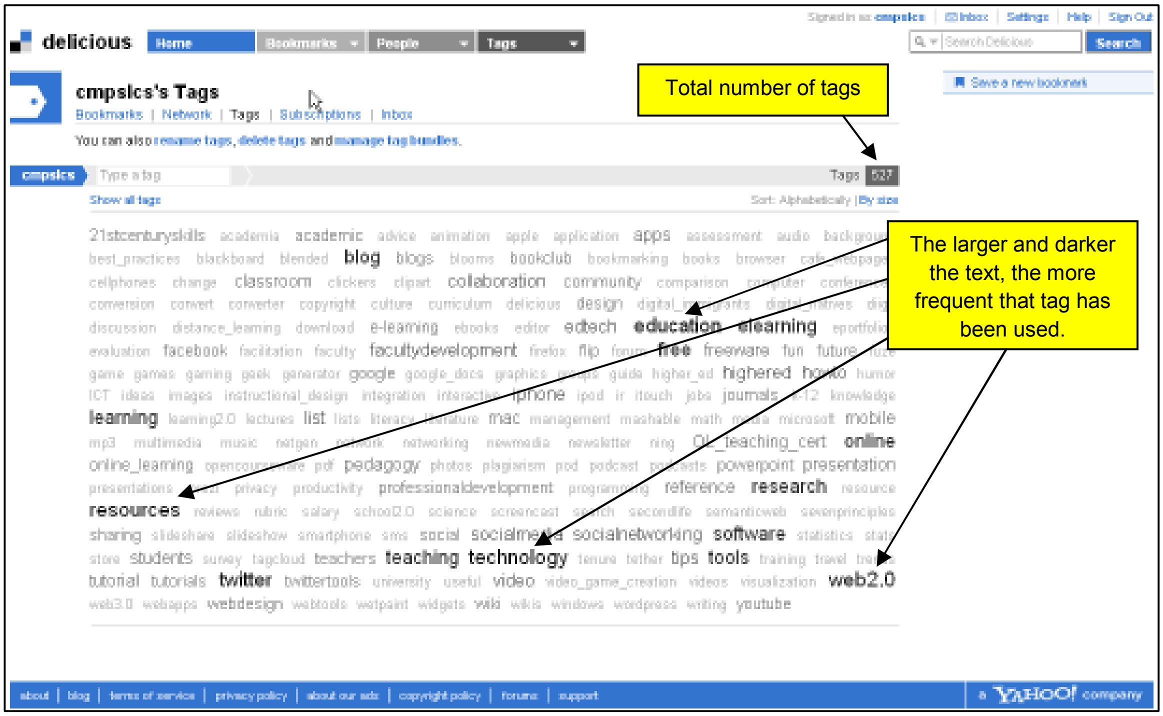


Figure 11. Word cloud of top tags



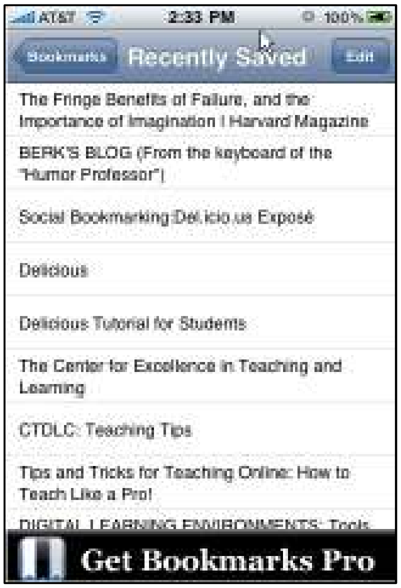
For those of you who would like to use delicious on your smart phone, I am including some screen shots of the delicious app on an iPhone. Figure 12 displays the delicious app on an iPhone page. Figure 13 displays the homepage of the delicious app while Figure 14 displays the listing of recent bookmarks. The input screen used to tag a bookmark is displayed in Figure 15.

Figure 12. delicious app for iPhone

Figure 13. Homepage of delicious app

Figure 14. Recent bookmarks

Figure 15. Input screen for bookmarks



So now that you know how delicious can help you, get started by going to the delicious homepage, creating your account and begin bookmarking. In a time when so many of us don't work within the confines of a 9 to 5 job and a lot of our work is done from home, delicious can be a lifesaver.

REFERENCES

delicious. (n.d.). Retrieved February 11, 2010, from delicious http://delicious.com/help/getStarted

Wikipedia. (2010, February 11). Retrieved February 11, 2010, from Wikipedia, the free encyclopedia : http://en.wikipedia.org/wiki/Social_bookmarking

Dr. Lori C. Soule *is the Director for the Center for Advancing Faculty Engagement (CAFÉ) at Nicholls State University. Dr. Soule received her Ph.D. from LSU in educational technology. She can be reached at lori.soule@nicholls.edu.*