

DEVELOPING HABITS OF MIND FOR NUMERACY IN A LOW-LITERACY CLASSROOM: A FOCUS ON ATTITUDES

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ABSTRACT

Many of today's adults, both native and non-native speakers of English, do not have the necessary math skills to be considered numerate in the world around them. Their lack of skill may lead to serious anxiety about mathematical concepts or a negative attitude towards learning new concepts. Simple tasks, such as the "Math Problem of the Day," when used deliberately to develop key "Habits of Mind," can help students develop positive attitudes towards mathematical knowledge. This will ultimately result in a more successful mathematical experience in academics and the world around them.

FRAMING THE ISSUE

When 58.6 percent of the general U.S. population and 91.6 percent of learners in adult education are assessed as lacking the numeracy skills necessary to be successful in life (Manly, 2008), adult numeracy instruction becomes critical on a national level. Numeracy is composed of the mathematical skills needed within the context of everyday life, and as such, is constantly changing to meet the demands of circumstances in the home, workforce or other cultural situations (Kerka, 1995). Adult students, both native and non-native speakers of English, must be taught to use mathematical content flexibly to meet the needs of their context.

In order to equip adult educators with tools for effective numeracy instruction, the state of Minnesota has introduced an intensive teacher training program, the Minnesota Numeracy Initiative (MNI), which provides access to online courses, peer observations of mathematic instruction, and discussions on coursework and curriculum with educators across the state. Since joining MNI in September, 2010, my emphasis has been on sound practices for numeracy development in an adult low-literacy classroom, composed primarily of English language learners. Initial curriculum changes included the introduction of explicit mathematical content, such as addition or basic algebra, as well as themed units related to academics or the workforce, such as working with historic timelines or measuring liquids for cleaning.

When I began introducing these aspects of numeracy instruction into my classroom, many of the students exhibited fear and discomfort, or in some cases, simply shut down for the day. This is not uncommon in adult education classrooms, unfortunately (Ginsburg, Manly, & Schmitt, 2006). Attitudes and myths about math must be understood, considered and worked through in order to guide students towards a healthier understanding of their numeracy needs and abilities. In addition to expanding students' mathematical abilities, I began to focus on

encouraging students to have positive attitudes toward numeracy in their lives and in the classroom, through an adaptation of “Habits of Mind” for mathematical learning.

Habits of Mind

Costa and Kallick (2000) describe a series of sixteen behaviors and attitudes that can be applied to problem solving and learning, particularly when information is not completely understood, called Habits of Mind. These Habits of Mind, when used as patterned behaviors, result in critical thinking about problem solving and learning that leads to better outcomes in real-world situations. The sixteen listed Habits of Mind, Costa and Kallick emphasize, are not unchangeable; additions that improve problem solving are encouraged.

Taking this as a starting point, the Massachusetts Department of Education (2005), in their Adult Basic Education Curriculum Framework for Mathematics and Numeracy, identifies key Habits of Mind critical for numeracy instruction. Rather than asking teachers simply to focus on a list of patterns or algorithms to teach students, the framework posits these Habits of Mind train students to acknowledge not only what is learned, but also how and why concepts are learned. Once teachers have internalized the Habits of Mind themselves, they are better equipped to demonstrate them to students in a meaningful way. Massachusetts Department of Education includes the following Habits of Mind, described in detail below: Curiosity, Respect for Evidence, Persistence, Ownership and Reflection (Massachusetts Department of Education, 2005, p. 16).

Curiosity involves a willingness to try new things in relationship to mathematics, not only related to new math content, but also including new methods or approaches to problems. Students learn to ask questions such as, “Why,” “How,” or “What if?” as they pursue different ideas in order to keep their minds open, even when concepts might become confusing.

Related to this is Respect for Evidence, which involves evaluating the answers to the questions raised above. Students must train themselves to listen to the explanations given by others, including teachers and other students, and in turn be able to explain their own methodology clearly and concisely. It is not enough to be able to complete a mathematical function; students must be able to understand and explain the reasoning behind their work.

Perhaps one of the most important Habits of Mind is Persistence. It can be difficult, especially after years full of anxiety and misapprehensions about math, to continue to work with numeracy. Becoming numerate is a long-term process that includes any number of challenges. Students must be encouraged to keep trying to understand and

explain their numeracy work, even when it becomes very difficult. Teachers can facilitate this by high levels of encouragement, particularly in determining what students already can do mathematically, and building on those skills.

Students also need to feel a deep connection to the work itself. They take Ownership of the work they are doing when it has value for them. Teachers may need to demonstrate the importance of concepts initially, but ultimately students need to be able to make such connections as they continue to grow as numerate individuals. This will help them learn as they experience new and difference mathematical concepts and methods.

The final Habit of Mind is Reflection, in which students look back on what they have learned and how they learned in order to prepare for future experiences. This is an important step to becoming a self-aware, autonomous learner. Students will continue to encounter new mathematical concepts after leaving the classroom and will need to remember the tools learned in the classroom to face these challenges. Leaving school knowing what and how they have learned will enable students to succeed at acquiring additional skills when there may not be a teacher present.

These five Habits of Mind encourage a numeracy teacher to go beyond theorems and equations into the meaning of mathematics, producing learners who are eager, excited and willing to work to understand, explain and continue in math classes as they become numerate individuals. Providing a classroom that encourages and models these characteristics in connection with explicit math content instruction will change students' attitudes towards math and assist them in meeting their numeracy goals.

Participants

Learning Lab A (LLA) serves students who are in the very initial stages of preparing for the GED. This includes both native and non-native speakers of English. All are reading below a fourth grade level, with the majority around second grade. Most have math scores around a first or second grade level. The goal of the class is to improve reading, writing and math skills while teaching content knowledge in science, social studies and literature.

The majority of LLA students, around 75%, are non-native speakers of English. Most of these learners have taken ESL classes in adult education programs already, and teachers have noticed that their oral skills have developed at a normal rate, while they continue to have significant struggles with written English. Many are uneducated in their native language, due to spending much of their life either in a refugee camp or working an entry-level job. Many have self-reported mental health problems or physical injuries that led to difficulty learning. These

students tend to have very strong mental computation skills, though they may struggle with written conventions in the U.S., and they also tend to have trouble with applied mathematics, primarily due to vocabulary.

The other 25% of LLA students are native speakers of English. These students often report that they were in special education programs while in the K-12 system, have significant learning disabilities (or low cognitive function), or have mental health concerns. Some are also recovering from some sort of trauma, such as stroke or head injury. Many of these students tend to be strong in basic written computation, have a strong dislike of applied mathematics, and have mathematical procedures memorized very well, though they have limited understanding of why they work.

NARRATIVE

As my knowledge of numeracy best practices grew, I continued to teach explicit math concepts, but I was determined to bring more mathematics into the classroom in a way that gave me the opportunity to model and teach Habits of Mind. One of the lessons in an MNI course recommended doing an activity called “Number of the Day,” in which students could create equations to express a particular number (Foundations, 2009). I decided to alter this activity to “Math Problem of the Day.”

“Math Problem of the Day” is relatively simple. Every morning I write a math problem on the board and lay out some manipulatives that students enjoy using. The problem is always related to explicit math concepts the class has studied and often involves current science or history content. Students have a set amount of time to solve the problem before it is reviewed as a class. Students are encouraged to work first on their own, then ask a neighbor if they are confused, and finally ask me or a volunteer teacher for additional. I do not give students the answer. Getting the right answer is only a secondary goal; the primary goal is to be able to discuss the mathematical concepts involved and the process needed to find the correct answer.

The introduction of the “Math Problem of the Day” was met with excitement by many students, typically those who were at higher levels of math or reading ability. Students at lower levels of ability displayed frustration or resistance, particularly if they had already given up on acquiring mathematical skills. The more excited students took the opportunity to explain their work to others and encourage them to continue learning. Frustrated or resistant students listened to their peers explain with curiosity and attention. Table 1 below presents an example of a “Math

Problem of the Day,” the solutions the class came up with, and some explanation of how each Habit of Mind was explicitly part of the class.

Table 1. Sample “Math Problem of the Day” with Student Solutions

| | | | |
|---|---|---|--|
| Xuan ¹ needs to buy three pounds of grapes. Each pound costs \$2.99. She has \$10.00. How much money will she have left after buying her grapes? | | | |
| Solution 1 | Solution 2 | Solution 3 | Solution 4 (done mentally) |
| $\$2.99 \times 3 = \8.97 $\$10.00 - \$8.97 = \$1.03$ | $\$2.99 + \$2.99 + \$2.99 =$ $\$8.97$ $\$10.00 - \$8.97 = \$1.03$ | $\$10.00 - \$2.99 = \$7.01$ $\$7.01 - \$2.99 = \$4.02$ $\$4.02 - \$2.99 = \$1.03$ | $\$2.99$ is about $\$3.00$ $\$3.00 \times 3 = \9.00 $\$10.00 - \$9.00 = \$1.00$ Add in 3 cents = $\$1.03$ |

This math problem was part of a larger unit on reading ads, buying items and making change. I had trays of quarters, dimes, nickels, and pennies for students to work with, though most chose to complete the problem without manipulatives. As students finished with the problem, they moved on to other materials. Most solved the problem within about fifteen minutes using Solutions 1, 2, or 3. One person did the problem mentally, using Solution 4.

I typically start conversations about each problem by asking the class, “How could you solve this problem?” This phrasing is particularly helpful in reminding students that there are different ways to answer, promoting Curiosity. The question also serves as a reminder that I am focused on the explanation of their methods, rather than their answer itself, demonstrating Respect for Evidence. In the problem above, four solutions were given. The first two were the most common, with the students who could multiply opting for Solution 1, and those who could not yet use multiplication, Solution 2. Most students assessed Solution 3 as too time-consuming, due to the amount of borrowing, though they acknowledged that it led to the correct answer.

Everyone was impressed by Solution 4, though the majority of the class believed it was too difficult for them. The student who presented that solution had owned a business stall in her country. She was known in the class as one of the lower readers, but she was exceptional at mental math. Presenting her solution and being recognized by her peers and teacher gave her a level of personal satisfaction not demonstrated before. Her solution also led to a discussion of when students might use mental solutions, if they ever had and why the method has value, encouraging Ownership. As the class discussed the solution, students were surprised to learn that many of them use estimating while they shop, and that it was not as inaccessible a solution as they believed.

¹ I typically rotate through the names of my students when creating math problems; the name has been changed here to protect student privacy.

Table 2 shows some of the important ideas to remember while facilitating the conversation about “Math Problem of the Day.” It can be difficult to have much larger group discussion on the topic of Reflection, which is best suited to one-on-one conversations as students work through course material. I ask individual students where their difficulties persist, and have them assess what has been most helpful for them; reading solutions on the board, listening to others talk it through, using manipulatives to “act out” the problem before solving, or some combination of these. Students are not always accustomed to this process, so it takes time, but eventually they see the benefit to understanding their learning process, when I take the time to be explicit about it.

Table 2. Habits of Mind in the “Math Problem of the Day”

| Habit of Mind | Ideas for Inclusion in discussion |
|----------------------|---|
| Curiosity | Ask students “How?” and “Why?” and encourage them to ask the same questions of each other |
| Respect for Evidence | Allow time to discuss every possible method; encourage students to assess the practicality of each themselves |
| Persistence | Be present to encourage students to ask each other for help; share progress observed with students; ask students to share personal success stories with each other |
| Ownership | Use students’ names in the problems; discussing the spheres of life types of math will be useful for; discuss experiences using the type of math. |
| Reflection | Take time for longer-term one-on-one conversations between student and teacher about progress in acquiring mathematical skills and strategies that have helped the progression. |

REFLECTION

Using a “Math Problem of the Day” to explicitly model and talk through math problems has resulted in changed attitudes towards math, generally corresponding to the Habits of Mind described above. Rather than spending a large amount of time fearing new mathematical concepts, students are excited to see whose name is on the board and curious to learn what type of problem they will be solving. Because problems are connected directly to their lives in and outside of the classroom, they see the relevance and are determined to persist in understanding the content. Students take ownership of their own work when they are asked to explain their solutions and learn to respect each other’s while listening to additional solutions. When all of these attitudes combine, they work together to mold a student into an individual who is ready and eager to become a numerate adult.

“Math Problem of the Day” has a special impact on non-native speakers of English in the class. As the students have the opportunity to explain their work using methods from their country, they feel confident in their understanding of math concepts. They are also given the opportunity to learn the traditional U.S. methods of writing particular math problems when other students or the teacher present additional solutions, which helps to prepare them for standardized testing.

Students have reported seeing difference in their lives, both in the classroom and outside, since beginning “Math Problem of the Day.” Some tangible results students have reported include: pride in improved test scores, particularly on applied math standardized tests; willingness to try mathematical skills in the real world, such as making change with coins instead of simply using a card; passing an employability math test with such high scores that an employer found an opening to hire a student; and the ability to give meaningful assistance to children completing homework (including asking children “How,” and “Why?” as they complete work).

EXTENSION

These successes lead me to believe that creating positive attitudes towards math has a long-reaching, measurable effect in students’ lives. I feel that many of the 58.6 percent of the general U.S. population and 91.6 percent of learners in adult education who struggle with numeracy skills (Manly, 2008) could benefit from the deliberate introduction of Habits of Mind in their learning and ultimately their lives. I would call on all Adult Basic Education teachers, of both native and non-native speakers of English, to encourage students to develop these Habits of Mind in their attitudes towards numeracy as they build explicit numeracy skills.

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