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Tune-up in Math: A Journey to Reduce Test Anxiety

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ABSTRACT

This paper focuses upon small group learning in mathematics and methods of overcoming classroom challenges like math anxiety and unmotivated learners. Re-testing shifts the emphasis from punitive measurement of points to an indicator of strengths and weaknesses of the students. There is also an emphasis on the practical application of the Zojonc Module dealing with the optimal division of labor and Polya's problem -solving heuristics. Utilizing small group settings and retesting are two methods of helping learners overcome classroom challenges and their own math anxiety. This paper is intended to present methods to be used with adult learners or continuing education students

> ***Plato argued in his Republic that only the best students, the eventual guardian class, should be allowed to enter the ideal realms of mathematics. However, most would agree that to function adequately in our present society, a certain degree of mathematical competence is needed by everyone. The schools must at least prepare the low achiever to handle the mathematics involved in concrete, everyday problems and, whenever possible, direct the students beyond the concrete towards the enjoyment and fascination of mathematics (Beckman, qtd in Chang, 1986).***

During my tenure as a faculty member teaching teachers in Laredo, Texas, I learned a lot about what being an educator means. My students were all dedicated teachers pursuing their master's degrees. One of the things we discussed during the first class were the problems in their in their respective classrooms and how they faced them. Of all the concerns the most critical was students' fear of mathematics. Many of their students hated mathematics or suffered from severe

math anxiety (Chang, 1985). "Math anxiety is my worst enemy," reported Dr. Louise Raphael, Mathematic Professor at Howard University, Washington D.C. She stated, "I feel that I am teaching the most important mathematics class on the Howard University campus, but my students' fear of mathematics is the toughest battle standing in my way (Puffins, 2007)."

As most individuals are aware, math has always been a high-anxiety subject for many people. Students haven't changed much in the more than twenty years I have been teaching (Chang, 2002). In the article, "Math Teachers Must Join Students in the Process of Learning," I wrote," There are many similarities between then and now. For example, twenty years ago students complained that they did not know how to do calculations. At that time students didn't have calculators, because calculators were expensive. Now that calculators are very inexpensive, almost every student possesses at least one. Students use them to do the simple arithmetic, despite the fact that they can perform it more quickly with pencil and paper, as they did before popular use of the calculator. They still have difficulty with problem solving, and still don't know how to use calculators effectively and wisely (Chang, 2002)."

In the 1930's and 1940's, ten percent of community college students dropped out. Teachers were reluctant to use the name "disadvantaged," to avoid damaging the self-esteem of their students. The necessity of these labels seems to be a natural and accepted risk in the college world, and nothing to be changed or remedied.

By 1960, the population of "disadvantaged students" had grown to thirty percent of entering freshmen, especially in urban areas. Today, in some metropolitan areas, up to seventy-five percent of the entering freshmen in the community colleges need some form of remediation in various areas of study - math is the one top areas on the list (Chang, 2005).

Developmentally challenged students did not always have a special title. After 1980, they've been called various names, such as; disadvantaged students; less able students; special study students, or developmental study students. As a group, these individuals all express some level of hatred toward mathematics and have displayed both test and math anxiety. Therefore math anxiety, which is partly an American cultural myth, has had a significant negative effect on mathematics performance (Chang, 2002). Sean Cavanaugh, the author of "Math Anxiety Confuses the Equation for Students," reported, "In recent years, researchers and educators have delved further into the topic of math anxiety, or ways the students fail. Today, the issue is receiving renewed attention from educators." He emphasized that developing a better understanding of the causes and implications of math anxiety is key to improving the achievement for many students (Cavanaugh, 2007).

Mark Ashcraft, a professor of cognitive psychology at the University of Nevada, Las Vegas, indicated that the public may be inclined to see anxiety as simply a by-product of a student not understanding a math concept. Researchers believe students' self-doubts can be a prime cause of their struggles. In his research, Ashcraft further explained that "…in the case of math anxiety, such thoughts probably involve preoccupation with one's dislike or fear of math, and one's low self confidence (Cavanaugh, 2007)."

There are also other causes of math anxiety. The public school teachers in my class at Laredo State University recognized that their students lost interest as they fell behind. Their students didn't have the skills to progress. They were not able to relate the importance of mathematics with pragmatic values in real-life and thus developed an "active ignorance" because they thought math class was boring. Consequently a negative attitude toward math was developed and failure in mathematics was the subsequent result.

At Laredo State the teachers and I agreed that we needed to maintain a good learning environment, provide more real life activities and give the students second chances (Chang, 1980). A few of the teachers felt very uncomfortable discussing second chance re-testing. They thought students would take it as an opportunity to not pay attention in class and use it as a rehearsal for the next test. They further believed that students who were not motivated might not do the work, and eventually would fall further behind. While re-testing seems to give advanced students no real challenges, the teachers and I decided we needed to organize their classes into a small group setting. This setting provided a chance to discuss the problem as well as help each other solve it. We gave the best students more challenging problems that demonstrated a greater mastery of the skills and a chance to earn bonus points (Chang, 1983). We also decided to provide plenty of time for one-on-one study sessions and shared the idea with how to balance the classroom atmosphere with the re-testing method. Many advanced students would eventually end up needing a re-test or two throughout the semester, and they also enjoyed helping their fellow classmates.

An article titled" Small Group Assessment Methods in Mathematics" by John Berry and Melvin A. Nyman (2002) reinforces these ideas. The article refers to a report by Saljo (1970) comparing two learning activities. For one group, learning was simply provided by an external agent, a teacher, so that knowledge is passed on from teacher to learner. This is the traditional lecture format. In this method, learning involves storing and retrieving information for tests. For the second group, learning was a student-centered activity that changed the learner in a qualitative way. Through students interpreting and understanding tasks, learning became an active process, rather than a passive one (Saljo, 1970). Berry and Nyman (2002) concluded that the advantages of team learning recognized that each individual learner has different strengths and weakness. They further concluded that working together as a team for both the learning and

the assessment process provided opportunities for these strengths and weaknesses to be explored. Tests became a measure of shared understanding instead of memorization (Berry, 2002).

There are some disadvantages according to Berry and Nyman, "…especially where students disagreed on an answer; however, the disagreement often lead to a wide-range discussion of the issue and hopefully a move toward agreement and the correct answer." Of course at times the teacher should intervene and provide a helpful hint to resolve the problem quickly.

An advantage observed by Berry and Nyman was that "….motivation has been increased by the small-group collaborative learning environment. The spirit has been one of cooperation and not competition." Learning by communicating with fellow students created an atmosphere of 'learning by doing' indeed of 'learning by watching.'"

During my tenure at Booker T. Washington High School in Atlanta, Georgia I had a class of approximately thirty students. In the third week I divided the class into several small groups according to a student's skill level. I placed four or five members in each small group. I appointed outgoing and mathematically-advanced students as co-leaders. During each class, we spent at least twenty minutes doing small group activities. I handed out activities and gave bonus points if the group could work through the problems and demonstrate them on the board. All the group members received bonus points. This provided a chance for the more accelerated students to master their leadership skills (Chang, 1977). The role of group leaders was rotated among the group, providing each student a chance to experience being the leader (Chang, 1979).

During the first week of the small group activities, several problems arose. I had to spend more time making sure that the students understood what was going on. Sometimes it took as many as twenty minutes to organize the management of the small groups. Occasionally, the seating had to be re-arranged or group members switched. Individuals also had to learn how to

manage group discussions. For each group I appointed one leader. A co-leader was chosen by the group and rotated every few weeks (Chang, 1986).

After the third week, after inaugurating of this activity, the class began to improve dramatically. Group activity visibly increased their interest in studying math, due to peer pressure and the groups' wanting to get bonus points. It also reduced disruptions in the classroom. The group leaders developed a range of strategies to provide problem-solving skills to other students. By teaching each other, the students gained a better understanding of the material taught. It also increased the leader's confidence and problem-solving skills. It also created an opportunity for the weaker students to ask questions and demonstrate their own talents in a more comfortable and less threatening setting. The weaker students served as co-leaders and were also instrumental in teaching the materials.

Students who were struggling benefited from peer-correction and assistance. A main advantage of this activity was to increase the level of participation and encourage students to engage in the Socratic method of discussion. As a result the more knowledgeable students assist the weaker students and the stronger students received reinforcement through their teaching activities. Surprisingly, when the weaker students had a chance to be a co-leader, they were more motivated to learn the material. When I gave out the material for the next day's assignment, they were eager to learn the lesson, so that they could help their group.

Later the weaker students wanted to do more challenging problems. They reported that they enjoyed showing other people how to do the problems. This was the very first time for weaker students to demonstrate what they had learned. After three or four weeks I observed that the gap between the strongest and weakest students had narrowed.

In another article, "Academic Performance, Sex Differences, and Attitudes toward Mathematics of Small Groups as Factors in a College Developmental Math Course (Chang, 1986)," there is a method to maximize the potential of the small group setting. One of the key elements is to teach the students the George Polya approach to solving problems, which is to first, identify the problem; devise a theoretical plan for solving the problem; carry out the plan, and finally, to reflect on the activity. It also describes Zajonc's Module for dividing up work in a small group. Zajonc's Module maximizes the potential of a small group. The small group setting provides an opportunity for students to solve problems as a team, instead of individually (Chang, 2002).

> ***"A final conclusion of this study is that a model dealing with optimal division of labor within task-oriented groups was found which was closely approximated by Zajonc. The Zajonc Model claims that the highest likelihood of a given item being remembered by at least one person in a group results when each person is assigned 0.42/k items where k is an empirical constant reflecting difficulty of the items. With k equal to 0.10 for an item (i.e., a very easy item) the optimal assignment is 4.2 items per person (Chang, 1986)."***

Re-testing serves to help students master skills. If they know that they will have a second chance, students' anxiety about tests is most often reduced. A second chance eliminates the punitive nature of tests and brings the focus back to making a test a tool for finding a student's weakness. The combination of offering re-tests and using small group teaching methods which emphasize Polya's problem-solving heuristics are effective tools for combating test anxiety. Teachers should have the absolute power to determine their own teaching methods and any method that helps a student achieve success is the best and most effective method (Chang, 2002).

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