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AUTHOR Biller, Jerry
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ABSTRACT

Students that have high mathematics anxiety also have negative attitudes toward their potential success in mathematics. The focus of this paper is on changing attitudes towards mathematics, particularly those of arts majors. Suggestions for changing attitudes come out of an understanding of differing learning styles among students. Individuals learn best when they are comfortable with the learning situation. For example, students at the Ringling School of Art and Design were rated using the Myers-Briggs type indicator as being predominantly of the intuitive perceiving style. These learning styles are often associated with right-brain learning whereas mathematics is often associated with left-brain learning. Such students should have opportunities to solve problems by self-instruction, group activities, and teacher contact as they like to pursue problems in their own way and work on assignments that make sense. In conclusion, educators must actively involve students in the learning process and provide a relaxed, productive environment for learning, be innovative in approach by allowing for varieties of learning styles, alter student attitudes by broadening the mathematics curricula, develop more effective ways of connecting classroom experiences to the workplace, and demonstrate that the purpose of teaching is to promote learning. Contains 24 references. (PVD)

REDUCTION OF MATHEMATICS ANXIETY

JERRY BILLER
Ringling School of Art and Design

Mathematics anxiety is an important educational issue. Students that have high mathematics anxiety also have negative attitudes toward their potential success in mathematics. "From kindergarten through adult education, it is becoming increasingly necessary to provide students with a better, more positive understanding of mathematics as a tool, as a language, as a method of perceiving and defining the world, rather than as an experience in frustration and failure" (National Research Council, 1989).

Many adults capable of learning mathematics are blocked from growth and opportunity because of their fear of mathematics. Tobias would argue that it is a fear of nerve not intellect that causes the problem. Some people believe you need a "mathematical mind" to do mathematics. If they believed they could do it, had some success, their attitude would change. They would increase the possibility to do what they thought they could not. The prevalence of math anxiety has fostered an abundance of math anxiety workshops throughout the United States. Frances Rosamond has been designated as the person responsible for all national university programs.

Autobiographies of math-anxious students showed teacher reassurance made no difference. According to Suinn, developer of the MARS (Mathematics Anxiety Rating Scale), "Mathematics anxiety is a fairly common problem in a college population" (Llabre, 1984, p. 436). He also felt that these tensions created by mathematics carried over in students' everyday lives. "Research among college students has shown that the study of mathematics generalizes anxiety reactions among students who are not necessarily highly anxious in other situations" (Bisse, 1993 , p.1). The problem of students experiencing math anxiety is a difficult one to solve. It has been present for a long time. It develops as a result of some negative experience which could have been any number of or combinations of reasons. The fact that it happens sets the stage for further compounding of the problem. This anxiety can lead to indifference and discipline problems. When emotions take over the learning process, the frustration that results can lead to "giving up" and failure.

It has been found that students with math anxiety had lower achievement. Students with high anxiety did better when less mathematical approaches and more visual approaches to problem solving were taught (Gabel, 1983). One of the five significant predictors of math avoidance was math anxiety. The highly anxious student performs poorer on math performance measures and are the least confident in mathematics skills. Results show that

high test anxiety in mathematics is experienced by both men and women. It has been found that students with negative attitudes exhibit a high degree of math anxiety. We need to change their attitude toward math.

In looking for the best approach to teach and interrelate mathematics and art, we must consider what the Education Policies Commission considers the central purpose of American Education and that is "the ability to think" (Shane, 1981). The concept of the learner as a constructor of knowledge is essential to any curriculum. "Students who construct their own mathematical understanding transform their mathematical potential" (Office of Research, 1993, p. 5). Methods of reasoning are the same in art and math. They are intersecting and related in meaning. They both are experimental tools that facilitate a transfer of learning for the art student.

Bickley, in her article, "Math and Art Curriculum Integration", hypothesizes that "congruent content between the disciplines of visual arts and mathematics exists and by attending to these congruencies, both math and art educators can provide more effective instruction through coordinated curricula" (p. 6). We need to evoke active rather than passive participation in the learning process. Milton Cox, a university director for teaching effectiveness, spoke at the Lillywest Conference on College Teaching held at lake Arrowhead in March of 1996. While he spoke, he surveyed the audience for some of the teaching approaches they felt were emerging in college teaching. The top four were collaborative and cooperative learning, computer-technology, active learning, and student focused learning. "Learning is not a passive process that is performed by someone else. It is active, personal, and purposeful, something meaningful and important" (Ross, 1994, p. 1). One is not teaching unless learning is taking place. Not all method of instruction are ideal for everyone. The attitude and personality of both the faculty and students must be considered.

Cooperative groups within the learning environment places the student in a role of an active learner who is responsible for their learning. Within these groups, the better students become teachers and actually deepen their own understanding. The role of the faculty member is moving from being the lecturer to that of a learning facilitator. The cooperative group helps the student to learn to work more effectively with each other in helping each other master the material. They develop patience, confidence, and become more motivated. We can "see learning in action" by seeing action in our learning.

In active learning, the student will no longer passively receive information but become part of the learning experience. Individual learning styles must be considered because "active

learning is based on the assumption that all students learn and remember differently" (Glasgow, 1995, p. 4). They may make mistakes but this too can be transferred to a learning experience. "The arts invite students to be active participants in their world rather than mere observers of it" (Fowler, 1994, p. 8). This means teachers must assume new roles. They can no longer teach by telling. "A paradigm shift is taking hold in American Higher Education" (Barr, 1995, p. 13). Colleges have been institutions that provide instruction and we are shifting to ones that produce learning by whatever means works. Lecturing now becomes one of the possible ways to deliver instruction but not the only one. In the current learning paradigm, the colleges purpose is to create environments and experiences that help students discover knowledge for themselves, not just transfer knowledge. It "embraces the goal of promoting what Gardner calls 'education for understanding'" (p. 24). Students need to be challenged and they need to be involved in the learning process.

Tell them and they forget.

Show them and they remember.

Involve them and they understand.

Chinese Proverb

The combination of art and math would serve to balance their education through the combination of creative imagination and logic. They are developing the ability to describe, analyze and interpret skills that relate by utilizing the critical thinking process.

Developmental mathematics courses, supplemental support math programs, and the large number of students retaking courses verifies the deficiency in mathematics ability of students entering college. Many art students commonly experience high anxiety when involved in mathematical tasks. The traditional mathematics classroom fails to establish a comfort zone for these students.

High school math teachers were taught in bits and pieces and they, in turn, teach that way. They test on these pieces. Some students never get these pieces together to see how they relate. The curriculum is driven by time not achievement. Mistakes are not allowed in the system. Yet mistakes could be the window of understanding that students need. They are just not built into the traditional mathematics lecture class. Memorization takes the place of understanding. The typical high school class is structured with a left hemisphere approach to learning. Kitchen feels that schools have failed to give adequate stimulation to the right side of

the brain and tend to discriminate against right-brain dominance. Williams contends that this is a mistake because "right-brain thinking" is essential to problem solving and creativity. Researchers do not abandon the study of male/female differences because they do find evidence that shows males to be more skilled in "spatial visualization"(the capacity to visualize shapes moving through space).

We are specifically addressing students at an art college and the left brain/right brain theory "accounts for tendencies of many students who practice math avoidance or experience math anxiety" (Kitchen, 1991, p. 3). The dominant right-brain characteristics of being an artist as having special qualities has also been the characteristic that has allowed them to alienate themselves from the left-brain world of mathematics. We need to change this perception of one or the other and instead instill the realization that the whole brain person will be a better artist. There is too much math in art and art in math to consider one without the other. We would change the student's state of mind and reframe their attitude toward math by putting art into their math classes. Bickley (1995) contends that when putting art together with math ideas, the art "constitutes an illusionary base for thinking, interpreting, knowing, and problem solving" (p. 15).

Brain research suggests that we are born with the ability to do all known mental functioning. The dislike of mathematics probably has many different starting points in a child's life. One could be in the way math is taught. In the process of learning anything we go through stages and particular learning styles develop as a result of our experiences. With the learning style established, one of the dislikes of math can come from the dislike of the nondiscursive, didactic style of teaching. This is further supported by the research of Katz. She points out that knowing something of how we learn is necessary before changing the mathematics curriculum. The learning styles within a particular college or department should be considered before making the decision to change or how to change. The changes need to be designed to fit the needs of the individuals we are working with. Constant awareness of revision needs to be done since the "cognitive maps" are continuously reshaped by how we learn.

Using the Myers-Briggs indicator, the four-year study of student learning styles at Ringling can be summarized by saying that those students were predominantly intuitive, perceiving students. Intuitive meaning they should have opportunities to solve problems by self-instruction, group activities, and teacher contact. The perceiving style means that they like to pursue problems in their own way and work on assignments that make sense. David Kolb theorized that individuals learn best when they are comfortable with the learning situation.

Using his learning styles inventory in some of my classes, the results indicated that those students gather information by observing. They like to generate ideas and they are imaginative and sensitive. We need: activities that utilize characteristics found through the learning style inventories; structured classes that allow students to participate in trusting, cooperative, and collaborative relationships; environments that are relaxing and motivating; and, provide students with the opportunity to express themselves in creative and imaginative ways.

In the actual implementation of methods to change student behavior and/or anxiety, the process would begin with the initial introduction to the program of mathematics . The course's relationship to specific art majors would reflect the anticipated benefits to be obtained. These would be presented in a visual mode, such as a video. The classroom environment must a relaxed, non-pressure atmosphere. Instructors would be trained in effective methods of instructional approaches which address the various learning styles. They would also assume the role of facilitator, rather than of teacher. Students would be involved in the learning process. Tests would not present the threat of an end in itself. They would be utilized as another method of instruction, another opportunity to learn. This would provide the student with methods to obtain the proficiencies before retesting them. Computers would be the primary method of instruction because of their use throughout the art majors and its effectiveness of presenting mathematics in a more dynamic mode. The use of computers in math class can provide the student with challenges not possible until now. They will be able to understand concepts more completely by the increased availability to explore and analyze. They will have, in the words of H.E. Huntley, "The experience of creating something new or of uncovering some hidden beauty is one of the most intense joys that the human mind can experience". 197;

An example of an activity would be the physical construction of a geometric shape. Students would then manipulate it to view its various properties. Then, on the computer, they would individually recreate the shape and attempt to manipulate it. By experiencing the relationship of mathematical concepts in the art they love, they will hopefully gain a positive connection and an increased level of motivation. Eric Jensen recommends such an activity for the development and enhancement of spatial intelligence. Students would work in groups of two or three for many of the activities including making original problems related to the concepts covered in class. The classroom should convey a relaxing atmosphere by personalizing it with student work and playing videos with imagery and music; combining art and technology to balance the left and right side if the brain.

John Dewey spoke of knowledge as being part of the learner's life. "Knowledge worth understanding". He believed knowledge and experience are different in that we acquire knowledge. We learn by processing experience. Some processing of information "takes place automatically as a consequence of the brain's ongoing search for meaningful patterns in experience" (Caine, 1994, p. 155). Instructors can facilitate and guide this search. Our task is to capitalize on and enhance the natural capacity of the brain to discern patterns and make connections. We are actively searching for the path to understanding rather than to just memory. This "active processing" consolidates and internalizes information so that it is "personally meaningful and conceptually coherent". For some students, this may be the only way to take sense of experience.

According to Socrates, knowledge was to be sought within the mind and brought to birth by questioning. He contrasts perceiving (the observation of things outside oneself), with reflection (the discovery of what is within); an activity he held to be common to both mathematics and ethics. For Socrates, it is reflection that helps understanding. This reflection would be likened to Dewey's "Learning Loop" and is vital for understanding. In most classrooms, this is just the time between the question and a student's answer. A more appropriate time-frame must be allocated. The Socratic seminar engages the students in active learning. "The assumption is that when students actively and cooperatively develop knowledge, understanding, and ethical attitudes and behaviors, they are more apt to retain these attributes then if they had received them passively" (Tredway, 1995, p. 3). "We must teach for understanding in order to realize the long-term payoffs of education" (Perkins, 1994, p. 1). Understanding requires more than hearing or seeing.

If we want our students to succeed in the 21st century, they must be motivated and better at working with others. We must: actively involve them in the learning process; provide a relaxed productive environment for learning; be innovative and creative in our approach, allowing for varieties of learning styles; alter the student's attitudes by broadening the mathematics curricula; develop more effective ways of connecting the classroom experiences to the workplace; and, demonstrate that the purpose of teaching is to promote learning. As Carl Rogers said, "Not the lifeless, sterile, futile, quickly forgotten stuff that is crammed into the mind of the poor helpless individual tied into his seat by ironclad bond of conformity" (1981, p.18).

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