



INNOVATION ABSTRACTS

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COMBINING WRITING AND COOPERATIVE LEARNING TECHNIQUES IN MATHEMATICS

The combined effects of cooperative learning techniques and writing across the curriculum approaches develop students' writing, editing, debating, discussing, and critical thinking skills. While I implement a variety of valuable affective and content-oriented techniques in all of my math classes, I find them especially helpful in developmental math where even more students deal with math anxiety, feelings of isolation associated with their limited understanding of math concepts, and a myriad of social problems.

A Welcome to Class

Two weeks prior to the beginning of the semester, I send a letter to my students. What a surprise! They find a welcome-to-class letter, directions for their first assignment—a math autobiography (due at the first class meeting), and a course syllabus. The letter is not intimidating and is actually quite humorous. Students are promised help from many sources and assured that this will be an interactive class. I include two phone numbers, my office and my home. The students are encouraged to call if they have questions or concerns.

Most students react positively to this outreach effort. Those who have concerns call to clarify my expectations and their roles in class. Some students call just because they have been encouraged to do so and like the idea of talking to a teacher before the semester begins. The letter sets a tone of high expectations, giving the students an assignment prior to the first class, suggesting that they read the first chapter of the textbook, and describing the time they must expend to be successful in the course. They learn that, in this class, students will not simply come, listen to a lecture, and then go off to fend for themselves—it will be a collaborative experience. Students who feel this approach would be inappropriate for them may discuss their concerns prior to class and make course changes if they wish.

A Mathematics Autobiography

Because most students have a high degree of math anxiety, I ask them to write about their feelings and describe their past experiences in math courses. In addition to addressing specific questions about math anxiety and other issues, it draws out students who have an interest in or ability to write but who lack expertise or confidence in math. Students often feel that they have abilities in only one area, such as English. By associating writing with math, I hope to expand students' awareness of their abilities in this area, also.

Student Interviews

I ask students to interview each other and introduce their new math buddies to the whole class. To help students focus on questions of interest, they are asked to write about themselves. Some of the questions from the autobiography assignment are repeated to encourage students to reflect upon what they have already written and edit their initial responses to the questions, including: "How do you feel about math?" "What are your concerns about this course?"

Discussing their feelings helps students understand that they are not alone with their anxieties, that they share common feelings about a difficult subject, and that I am aware of their feelings and will discuss them openly. Once students are comfortable talking to a new classmate, I ask them to read the syllabus together, using a pair-reading format. Each partner in a pair explains one paragraph of the syllabus while the other listens and asks questions. If they agree on the interpretation, they switch roles. If the partners still have questions, they may ask for my advice.

A Learning Contract

Students enter into a learning contract with me; we each have vested interests in the outcomes of their efforts. I designed this contract with two goals in mind: to highlight my approaches and responsibilities, and to emphasize students' responsibilities (and I include a list of suggested activities which will help them succeed in the course). The contract helps formalize my helpful



suggestions and emphasize the serious nature of the agreement. Moreover, it helps focus students on the study habits and learning approaches that are critical to success. It reaffirms the collaborative nature of the class and further encourages student participation in this non-threatening, risk-free environment.

Post-Exam Questionnaires

Post-exam questionnaires encourage students to reflect upon their responses and feelings regarding their performance. Students are encouraged to correct mistakes immediately after completing the exam, then write about their feelings after having made their corrections and after their exams are graded and returned. Also, they are to consider what they should do to improve their performance and what I could do to help them. Most of their responses are written immediately after the exams are returned; however, their responses to what they and I can do to improve are completed as a homework assignment to allow more time for thoughtful consideration. I return each of the student questionnaires with my comments and suggestions at the next class.

The One-Minute Paper

At the end of each class, students respond to two questions: What is the most significant thing you learned today? and What question(s) do you have? These questions may be open-ended and general or directed to a particular part of the class or a concept. The papers may be submitted anonymously or signed; early on, I recommend anonymity as it encourages students to participate and provides useful general information. When students become familiar with this self-assessment activity and learn to trust my responses, I feel better about asking them for signed papers; then I can respond directly and privately to individual students. This exercise encourages students to reflect on that specific class and review and synthesize what they learned.

Using Print Media for Practical Applications

Print media provide a rich source of real-life, practical examples for illustrating concepts and are especially useful in mathematics. Mathematical principles or operations may be used to explain an author's opinions, highlight themes, and/or justify conclusions. Newspapers' business and sports sections are especially rich sources of math-based articles. Even comic strips have multiple examples of subtle humor using math concepts or society's anxieties about math, in general. I ask students to discuss three articles, from print media of

their choice, which use mathematical principles to make a point. I encourage them to read magazine articles about their hobbies or newspaper stories about their special interests. They must describe the article or story, explain how math was used, discuss whether the article changed or reinforced their opinions, and explain their conclusions. Their analysis must include an explanation of how math was used to help convince the reader that the article's thesis was correct and whether the author succeeded in making his/her point convincingly.

Explaining Problem-Solving Techniques

Frequently, students are required to explain, in writing, the techniques they use to work through mathematical problems. Students divide their worksheets into two columns—working through the problem in the left column, using a sequential step-by-step procedure, and writing their explanation of each step in the right. In this assignment, students are asked to focus on their thought processes as they attempt, for example, to solve a word problem. A significant problem associated with word problems occurs when students become distracted by the story line; when they write out their distracting thoughts, along with the mathematical steps to solving the problem, they are able to see more clearly how distracted they can become. Writing helps students focus on the process and increases their ability to concentrate on the problem, especially when they work in pairs, complete problems together, think critically and reflectively, clarify what they know and what they do not, formulate questions, and learn difficult concepts. In that effort, they also learn that, very often, two heads really are better than one.

Conclusions

Writing, especially when combined with cooperative learning activities, helps improve student motivation. Students have valuable opportunities to play a strong role in developing course procedures, reflect upon their performance and attitudes, enjoy important social learning experiences, and participate in a classroom atmosphere where critical thinking is encouraged and supported.

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