Humanistic Mathematics Network Journal

Issue 4 Article 14

12-1-1989

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Humanistic Mathematics, Part A

The role of the knower in mathematics, CATHERINE GORINI, Maharishi International University. Knowledge has three components: the knower, the object of knowledge, and the process of gaining knowledge. Modern education focuses on the object of knowledge although the knower is certainly the most fundamental component of knowledge. An understanding of the nature of the knower, the mathematician or student of mathematics, has direct applications in mathematics education. Experience with this approach will be discussed.

Mathematical thinking and heuristics, JOHN LUCAS, University of Wisconsin-Oshkosh. Mathematics is a product of human thinking and problem solving. In the teaching and learning process, those reasoning techniques (heuristics) which help us produce mathematics and solve new problems are even more important than mathematics itself, because they are the essence of the human ingredient--the "production mechanisms" by which mathematics evolves and becomes an extension of our thinking. Conveying mathematics by emphasizing heuristics motivates and challenges students by appealing to their creativity and involving them actively in the process of discovery. This talk explores some common myths about the learning of mathematics, examines the nature of heuristic, and offers some examples of how emphasizing human reasoning in the classroom can enhance learning.

Using the history of mathematics to generate interest in forging its future, EMELIE KENNEY, Wilkes College. Many secondary and beginning college students think of mathematics as a stagnant body of long-before discovered facts--all mathematics has already been discovered, they seem to think. Unfortunately, mathematics is sometimes presented this way. We should change students' perceptions not only for accuracy's sake, but also to promote curiosity, inventiveness, and desire for discovery. Introduction of historical elements actually helps to effect the change. Here, several ways of introducing mathematics history in the curriculum are discussed, and some examples are presented to illustrate how this may be accomplished.

Introducing undergraduates to mathematics information resources, SALLIE BARRINGER, Trinity University Library. Undergraduate students of mathematics have traditionally not been heavy users of library materials in mathematics. In most of their studies, they concentrate on learning the "basics" of mathematics, often to the exclusion of developing any sense of the history of mathematics, range of mathematical literature, or methods of mathematical research and inquiry. This talk describes three mathematical alternative, library-based assignments requiring students to use and evaluate a variety of materials that could be integrated into intermediate and advanced level undergraduate mathematics courses, and would promote students' understanding and appreciation of mathematics as a rich and diverse discipline.

Presenting problem solving as a universal activity, GEORGE DAY, Allegheny college. Problem solving is the process of combining intuition, knowledge, and skills, toward the satisfaction of a need or desire. John Mason's paradigm of mathematical problem solving can be used to demonstrate the similarity of the mathematical process to other creative activity. Students who, in the same course, examine the relevance of his model to non-mathematical situations and also use it to analyze and improve their own mathematical techniques, may see more clearly that doing mathematics is a natural human behavior.

Let us teach philosophy of mathematics, REUBEN HERSH, University of New Mexico. A historically oriented humanistic course in the philosophy of mathematics will be described. Such a course is advocated as a more exciting alternative to the traditional foundations course.

Mathematics and the existence of God, PAUL R. MANNING, Oratory Preparatory School. The general public still does not seem to realize that there is a close connection between philosophy and mathematics. Pascal, Descartes, Newton, Russel and Whitehead, to name a few, have worked in both fields successfully. The modern Canadian Philosopher-theologian, Bernard Lonergan, has continued in this tradition. In particular, mathematics permeates his classical work, *Insight* (1957). This paper will focus on Lonergan's use of mathematics in the development of his "transcendental method". Finally, Lonergan's approach to the question of the existence of God will be compared/contrasted with the approaches of Aquinas and Pascal.

Mathematics and music, JOEL K. HAACK, Oklahoma State University. Several modern composers have returned to mathematical theories of harmony to develop systems of tunings that they employ in their work. Terry Riley, in particular, has developed a system of just intonation based on the first five pitches in the overtone series. The theoretical background of tunings and a mathematical analysis of this system provides the beginning of an explanation of the appeal of his music.

Humanistic mathematics, Part B.

Mathematics: a significant force in our culture, HARALD M. NESS, University of Wisconsin Center--Fond du Lac. A discussion of mathematics as a significant force in the development of our culture, the effects of the culture on the development of mathematics, and implications for mathematics courses for liberal arts students.

Mathematics appreciation: a humanistic course, THOMAS L. BARTLOW, Villanova University. The course described in this paper attempts to present mathematics in relation to other currents of the western intellectual tradition rather than as a subject separate from other trends in society. The course connects with intellectual history in three ways; by examining mathematical practices of ancient societies, by exploring the pythagorean philosophical view that number, and by extension mathematics, is the foundation of reality, and by studying the use of geometry to understand the nature of the universe. Many of the mathematical topics covered are common in a Mathematics Appreciation course; the distinctive feature of this course is examining them as part of a larger culture.

Topping the creativity and ingenuity of liberal arts majors, HELEN CHRISTENSEN, Loyola College in Maryland. A major challenge to the teacher of liberal arts majors who have a mathematics requirement to fulfill is that of preventing simultaneously the two extremes of frustration and boredom, with one being related to the background of the individual student. A course in graph theory applied at elementary level and centered around a "real-life" project that elicits student creativity and ingenuity often leads to the final evaluative statement: "This is the first mathematics course I've really enjoyed."

Mathematics for liberal arts, FREDERICK SOLOMON, Warren Wilson College. I have taught the course "Mathematics for Liberal Arts" for three years. It is an alternative to the Precalculus-Calculus stream and is also an alternative to Finite Math and Statistics. The course consists one-third of traditional mathematics, one-third history and philosophy, and one-third art and design projects. The latter are very popular with the students. The approach I take is entirely aesthetic. There are several goals: to connect mathematics with other areas of liberal arts, to involve students in aesthetic aspects of mathematics through projects, to relate to students who aren't interested in the mathematics subjects as taught in high school. Students are required to write papers and construct projects in addition to the normal types of problems sets.

Cosmologies, FREDERICK SOLOMON, Warren Wilson college. I teach a freshman seminar entitled Cosmologies. It covers different ways of knowing the world--in particular, physical cosmology, depth psychology, and the spiritual traditions. By combining these radically distinct approaches to understand the world in one course, the differences and similarities are apparent. The connection with mathematics is this: Training in mathematical thinking uniquely enables one to entertain imaginative constructions and to see their interrelations in the realm of abstract thought. The different ways of looking at the world--cosmologies--can be seen as distinct logical structures. To deal with them requires an axiomatic approach similar to that used in dealing with mathematical axiomatic systems.

Where are your eyebrows?, SHARON M. STENGLEIN, The College of St. Catherine. Most beginning calculus students have been successful at algebraic manipulation and have found satisfaction in completing mathematical problems correctly. Few have any sense of mathematics as a beautiful part of the history of human learning and culture. A variety of lectures, discussions and assignments are used to deepen students' understanding and appreciation of mathematics while "raising their eyebrows".

A course in the history and philosophy of mathematics, ROBERT W. OWENS, Lewis and Clark College. We studied epistemological and ontological issues concerning the nature of mathematical knowledge from the Platonist, conceptualist-intuitionist, realist, and empiricist perspective. Arguments for and against the notion of "a priori" knowledge were investigated, as were warrants for mathematical truths and justifications for changes in mathematical practice. Finally, we tested these philosophical arguments by considering the history and evolution of the calculus.

The rediscovery of hyperbolic geometry, DICK A. WOOD, Seattle Pacific University. Students will explore new ideas, develop novel constructions, and create new proofs by changing the Euclidean plane slightly. Just omit a region which contains some key point(s) used in the typical Euclidean construction. The students find it challenging and fun to form their own constructions. They hone writing skills when describing the idea and verifying its correctness. This can be modified to cover a wide range of skill levels.

Humanistic Mathematics, Part C

A "famous equation" seminar course, RICHARD G. MONTGOMERY, Southern Oregon State College. A history seminar-course is described wherein weekly public talks on "famous equations" were given by students enrolled in a supporting course. This format provided natural opportunities for dedicated individual research, talk preparation and expository mathematical writing within a supportive and instructive group environment. Strategies to make this a practical and humanistic approach while achieving quality results are detailed. Course mementos, including the anthology of student papers, are displayed.

Student initiated, team taught history of mathematics course, EDWIN F. BAUMGARTNER, Le Moyne College. At Le Moyne College, a liberal arts college in the Jesuit tradition, a senior studies course is required of students and its catalog listing is: " . . . to help them integrate their educational experiences and improve their ability to express their ideas." Besides certain specified courses, there is a "student initiatives" option under which "students are encouraged to seek out an instructor, as a group, design and pursue a program of study which meets the design and purpose of the senior studies requirement." In responses to student requests, we are offering such a course this term. None of us have taught such a course before, so three of us decided to team teach it as an overload. We wanted to make library research and report writing an integral part of the course. We also wanted to emphasize that both students and faculty were to be learning together. In addition to having regular textbook readings, students and faculty select and present reports and problems at our meetings. The topics to study were chosen by both students and faculty from a faculty generated list that was augmented by student suggestions. More emphasis is placed upon researching topics, and writing reports for the benefit of all participants, than upon oral presentations by students. Students are graded based upon individual learning contracts negotiated between them and faculty members. While only a month into the course, we're very hopeful of it being successful and of repeating such an experiment.

A mathematics seminar from the National Endowment for the Humanities, WILLIAM DUNHAM, Ohio State University. This past summer, the National Endowment for the Humanities sponsored a five-week seminar for school teachers entitled "The Great Theorems of Mathematics in Historical Context" and held on the campus of The Ohio State University. The seminar's director will discuss this unusual offering at the first mathematics seminar funded by NEH as part of its "Summer Seminars for School Teachers" program--with emphasis on the seminar's format and content, the response rate from across the country, and the general nature of an enterprise explicitly designed to examine mathematical masterpieces as landmarks of human creativity.

Applications, sources and research, RAYMOND F. COUGHLIN, Temple University. A difficult pedagogical challenge is to convince students that mathematics is applied in a wide variety of disciplines. Most textbook applications are clearly manufactured by the author and do nothing to convince the student of the applicability of mathematics. We have developed from journals and books a list of over 300 applications that present case studies of mathematics being used to solve problems in business, economics, the social sciences and the biological sciences. This talk describes several of these applications. In addition, we show how the applications can be used effectively in the classroom, how the student can find the referenced article or book in the library, and how further research on the topic can lead to a term paper or a class presentation.

Discussing and debating conjectures, ANNELI P. LAX, NYU-Courant. Students' preconceptions about the nature of mathematics and instructors' preconceptions about the nature of students often combine to hinder mathematical progress in our mathematics classes. Class conversations based on observations which lead students to formulate conjectures and to test, prove, or disprove them allow us to identify both sets of preconceptions and to tackle the misconceptions among them. Class discussions provide opportunities for explorations of both mathematical topics and individual learning styles. Such inquiries demonstrate the spirit of what we usually call "research" and confirm its crucial role in learning and teaching.

The communication of mathematics, a rational and irrational process, PHILIP D. EVANSTOCK, Park College and the Phoenix Union High School District. The teaching of mathematics is a process of communication, the purpose of which is to sustain and extend the knowledge of mathematics. It fulfills our technical and intellectual needs. However, the person communicating this knowledge is not always well defined. Indeed he/she may be a hindrance and/or a catalyst for the proper assimilation of this knowledge. This talk will focus on the mathematical teacher as a communicator of concepts, stress the nature of the teacher-student communication, consider some of the problems involved in this communication and suggest some solutions to the obstacles inherent in this human intercourse.

An empowering, participatory research model for humanistic mathematics pedagogy, ARTHUR B. POWELL, Rutgers University at Newark. A defining feature of a humanistic mathematics perspective is the notion that students and instructors can learn together. To ensure interdependent learning among actors in the classroom, a research paradigm which differs from conventional ones is required when investigating the effectiveness of instructional and learning techniques. Furthermore, since all investigative initiatives manipulate and transform reality, the methodology of this new research paradigm must skew change in the direction of improved teaching and learning and empowerment. This implies that all actors participate in the research which aims to meet the above criteria. For in actual practice, I will provide an example of a participatory research project conducted in a developmental mathematics course. The research concerned the ways in which personal, reflective journal writings best support the enhancement of mathematical thinking.

How women have been and are encouraged to pursue mathematical knowledge, SYLVIA SVITAK and MONA FABRICANT, Queensborough Community college. Mathematics as a humanistic endeavor must seek ways to enhance women's chances for successful pursuit of mathematical knowledge. Contemporary educational research points to a number of factors that affect a woman's decision to study mathematics and the history of mathematics strongly demonstrates those factors to be operative from the time of Pythagoras to the present. A supportive family environment, early successful exposure to significant mathematics and emphathetic role models are, among others, keys to fostering the development of women's mathematical abilities and expertise. This paper shows how the history of women in mathematics coupled with observations from recent educational studies can guide us to provide a nurturing environment in which women can study mathematics in today's culture.