Far East Journal of Mathematical Education
Volume 3, Issue 1, 2009, Pages 25-34
Published Online: April 13, 2009
This paper is available online at http://www.pphmj.com

TEACHING BASIC MATHEMATICS AT WEST LA COMMUNITY COLLEGE

TEDJA SANTANOE OEPOMO

Science, Engineering, and Mathematics Division
West LA College and LA Harbor College
California 90631, U. S. A.
e-mail: oepomot@wlac.edu; oepomots@lahc.edu;
t.s.Oepomo@csupomona.edu

Abstract

In this manuscript, an approach to teaching basic courses in mathematics and arithmetic to first year students in West La Community College is presented. The primary distinguish characteristics of our teaching methods include: providing a laboratory interactive process to teach the student the subject by means of an Inter Act tutorial software, focusing on practical sample problems as many as possible as an approach to understanding basic mathematics; and using home work assignments as many as possible as a way to develop intuition and understanding about the mechanisms of basic mathematics and arithmetic. The interactive process is provided by having the student carry out a series of laboratory exercises involving a direct Inter Act tutorial software lectures on basic mathematics. The greatest challenges in teaching an intellectually substantive course to entering students at a Community College are their lack, on average, of the basic mathematics and arithmetic background in their high school curriculum that is taken for granted at the collegiate level. In this paper, we demonstrate that by appropriate choice of material and presentation methods this challenge can be overcome.

2000 Mathematics Subject Classification: 00-01, 00A05, 00A35.

Keywords and phrases: Inter Act tutorial software, basic mathematics, arithmetic, just in time, learning in context.

Received September 5, 2008

I. Introduction

Over the past three decades, there have been significant changes in both the background knowledge and preparedness of students pursuing an Associate Degree at American Junior Colleges and in the core body of material that defines this field of study. Given these changes in both the nature of the entering students and the nature of the teaching of basic mathematics and arithmetic, it is important to reevaluate the way in which we deliver the two years of education that typically leads to an AS degree. One of the tenants of most AS curricula is that entering students interested in pursuing an AS degree should spend their first year at Junior Colleges taking basic mathematics and arithmetic courses, which are then prerequisites for courses in undergraduate mathematics. This effectively prevents most entering students from taking any college level mathematics courses during their first year at Junior Colleges. The implicit assumption in this arrangement is that until students have had sufficient background in basic mathematics and arithmetic, they cannot begin their studies of undergraduate mathematics. In this manuscript, we argue that teaching an intellectually substantive first basic mathematics and arithmetic course to first year student at Junior College is possible. We will also argue that teaching an intellectually substantive introductory basic mathematics and arithmetic offers a number of benefits to both the students and to the faculty.

We will support the above assertions by describing the intellectually substantive course given at the West La Community College, “Basic Mathematics”, which is taken by first year students at the West La Community College. This course was developed with the view that students knowing only very little basic mathematics and arithmetic at High School level should be able to progress and succeed in the course. One way to approach this goal would be to present a superficial coverage of broad range of basic mathematics materials while motivating and familiarizing students with a lot of home work assignments and work sessions at the computer laboratory to review the courses through a series of Inter Act Mathematics tutorial software. Although this is a laudable approach, we also wished to engage first year students in the intellectual underpinning of basic mathematics and arithmetic, e.g.,

operations of whole numbers, fractional notation: multiplication and division, fractional notation and mixed numerals, decimals notation, ratio and proportion, percent notation, data analysis, graphs, and statistics, and real numbers and their mathematics operations, etc. After careful consideration, we conclude that there are a number of important basic mathematics and arithmetic topics that can be taught in an intellectually substantive way to first year students knowing only very limited basic mathematics and arithmetic. Also, there are some basic mathematics and arithmetic topics that simply cannot be included, e.g., teaching students algebra: to solve equations and applications problems in an intellectually substantive way requires that the students have a solid understanding of basic mathematics and arithmetic. The last challenge that we faced was selecting a subset of basic mathematics and arithmetic topics that could be taught to first year student and then fitting them together in order to create an interesting and coherent overview of both basic mathematics and arithmetic.

II. Motivation for "Basic Mathematics and Arithmetic"

As we observed in Section I, over that past three decades there have been significant changes in the nature of students pursuing an AS degree in American Junior Colleges and in the core body of materials defines basic mathematics and arithmetic. These changes have resulted in a number of stresses on educational institutions offering a two year AS degree. In this section, we discuss some of these changes and indicate how they provide a strong motivation to educational institutions to offer an introductory course in basic mathematics and arithmetic to first year student. Although our observations are drawn from our experiences with first year students entering the West La Community College, discussions with our colleges at other American Junior Colleges suggest that these observations are true at school ranging from private Junior Colleges to large state four year teaching colleges to two year teaching colleges.

A. Mathematics background of incoming first year student

In the context of creating an introductory course in basic mathematics and arithmetic, one of the most salient features of the incoming first year

students is their background in basic mathematics and arithmetic. In general, there is an extremely high diversity in the mathematical background of entering students. Some have already had the equivalent of one semester of basic mathematics and arithmetic. Others have had noting more than very limited high school basic mathematics. Even though nearly all entering students have had high school algebra, we still find that solving two equations in two unknown requires review and practice before a majority of students become comfortable solving this kind of problem. Nearly all of entering first year students understands addition, subtraction, multiplication, and division of whole numbers. We find that almost all students have had some kind of high school basic mathematics and arithmetic. However, a significant number of entering students do not have any experiences or understanding of basic mathematics operations such as addition, subtraction, multiplication, and division.

B. Experiential background of incoming students

Another extremely important aspect of the nature of incoming first year students is their real-world experiences with electronics calculators and computers. During the past 20 years, there has been almost a complete reversal in experience levels of incoming first year students between electronics calculators and computers. Twenty years ago, when I was still an undergraduate student, relatively few students graduating from high school had significant experience in using electronics calculators or had significant exposure to computers. I was still using my Japanese made slide rule in my class. This lack of experience was primarily driven by the high cost of electronics calculators in those days (high school could hardly afford their own electronics calculators) and by the high complexity of programming these electronics calculators.

Virtually every single incoming students pursuing an AS degree knows how to program an electronics calculator. Another way for students gaining experience is through part-time and summer jobs taken during their high school years. However, in today's economy, a high school student is far more likely to be hired to work using some kind of electronics computers. This too means that entering students are far more likely to have experience in the use of electronics computers.

Thus, our introductory basic mathematics and arithmetic courses must be designed to provide an experiential context for the development of theoretical material and methodology.

C. Lack of knowledge about the practice of mathematics

While first year students entering West La Community College in Culver City are usually highly motivated, many of them do not have a clear understanding of what undergraduate mathematics are all about. Some have been encouraged to pursue a certain major that required a background in mathematics with little understanding of what that entails. Many are interested in taking mathematics, but do not have any clear idea of which discipline is proper for them. This lack of understanding on the part of first year student was not being alleviated by course work in basic mathematics and arithmetic because, as at most junior colleges, first year students were typically taking only preparatory and prerequisite courses such as basic mathematics and arithmetic. This means that many students had to wait until their second year to take their first real course in undergraduate mathematics. A negative aspect of having second year entry-level classes is that students who really do not end up liking the particular mathematics as a major can be trapped in that major; or they may require more than two years to complete their AS degree if they choose to switch majors.

As long as the "Basic Mathematics and Arithmetic" courses for first year students provide students with an overview of what mathematics is all about, students can make decisions about switching majors an entire year earlier. Carrying this one step further, the department of Mathematics and Computer Sciences at West La Community College has created basic mathematics and arithmetic courses for the department to be taken by first year students. This gives students a much broader understanding upon which to make their choice of a specific department in which to major. For those who discover that mathematics is not for them, this approach helps them to discover that fact by the end of the first year. We have entering students who are planning to pursue a career in liberal arts asking why we are trying to teach them anything about 1's and 0's. In order to combat this confusion, a "Basic Mathematics

and Arithmetic" course should attempt to maintain a balance between liberal arts and mathematics content; moreover, it should highlight the interdependence between liberal arts and mathematics majors.

D. Lack of patience

Whether it is unfortunate or not it is a fact that we live in an age of instant gratification. Students are not significantly motivated by the admonition that studying mathematics and science for the first year will prepare them to embark upon liberal arts and intermediate mathematics courses in their second year. Students subjected to this type of program frequently complain that "came here to study liberal arts, and all you taught me was mathematics." More than complain, many first year students will give up on liberal arts and mathematics as a career before they have ever even taken a single college level mathematics course. By offering a "Basic Mathematics and Arithmetic" course for first year student, we have the chance to demonstrate to them just how exciting mathematics can be. However, in order to entice students to pursue careers in mathematics, science, and engineering, we must make any basic course exciting for the students. It must present material in an accessible way and it should employ interesting material in an accessible way and it should employ interesting vehicles that can capture the student's imagination.

E. Lack of good study skills

The study habits of first semester student vary from non existent to extremely sophisticated. Unfortunately, it has been our experience that a significant number of entering students at West La Community College are smart enough that they never really had to develop good study skills in order to succeed in high school. Therefore, when they come to West La Community College and take "Basic Mathematics and Arithmetic", we must adjust to the fact that they are busy learning good study skills at the same time they are learning Basic Mathematics and Arithmetic. The Inter Act tutorial software in the Computer laboratory courses need to take this into account and need to help students learn necessary study skills.

III. West Los Angeles College Basic Mathematics

Because of the lack of basic skill in mathematics of incoming first year student, we found it increasingly difficult to teach the first year entry-level course in basic mathematics at West La Community College, "Basic Mathematics and Arithmetic". In this course, we were attempting to teach students about basic arithmetic, followed by operating whole numbers, fractional notation, mixed numerals, and operations in decimal notations. Many students just did not seem to "get" the importance of the fundamental relationships we were describing to them. They could see no possible practical use for the material we were requiring them to learn. Part of the problem was the student's lack of experiential context for the material we were covering. Part of the problem was the particular topics at the end of each chapter we chose for this class; e.g., problem solving was hard to grasp for students who really had little experience with real world problem solving. The courses that students take after "Basic Mathematics and Arithmetic" have all been designed to take advantage of the vastly improved level of preparedness of the students who have completed the basic mathematics course. Our "Basic Mathematics and Arithmetic" course not only provided following courses with a more uniform student background, it also provided students with a significant understanding of several important topics in algebra. In this section, we present the specifics of the "Basic Mathematics and Arithmetic" course that we taught. First we will present a list of goals that we wanted to achieve with our basic mathematics class.

A. Goal for the "Basic mathematics and arithmetic course"

Collecting all of the goals and constraints for a "Basic Mathematics and Arithmetic" course for first year students from Section II, we have the following:

- The course must be accessible to first year student knowing only simply basic mathematics in high school.

- The course should expose first year students to basic mathematics in an exciting and stimulating way. Students should have "fun" learning about mathematics. Students should be motivated to learn the materials.

- The course should realize that entering students may have poor study skills. Features should be incorporated into course to minimize the impact of their poor student habits and to help the students learn good study habits.

Satisfying all of these objectives simultaneously proved to be quite challenging. However, as we shall see later in this section, it was not possible.

B. Philosophy guidelines

There are a number of important philosophical guidelines that we followed in trying to put together a first year basic mathematics course that satisfied all of the goals enumerated above. The first and the foremost idea is that students learn best when the fundamental theoretical ideas of the basic mathematics are taught in the context of their real world usefulness. Much of the research in human learning clearly suggests that theoretical ideas are much easier to learn when the student already has experience with the variables and elements which are the object of the theory. In addition, when fundamental theoretical understanding is closely coupled to real-world experiences, the students are also more able to reason about how this knowledge could be used to solve different problems.

The second philosophy guidelines that we followed is that for maximum teaching effectiveness, fundamental theory must be delivered using just-in time teaching strategy. Under just-in time teaching strategy, fundamental theoretical ideas are introduced just when the student's experiences are creating a need for that theory. This requires extremely careful coordination between the specific experiences students have in the Inter Act computer software laboratory and the fundamental theoretical material that are taught in lectures.

The fourth philosophy guideline is that the course should employ only simple algebra and calculations by hand.

C. Helping first year students to learn more effectively

Two strategies that we have found successful in helping students to learn more effectively are: (1) encouraging attendance in lecture and (2)

providing an early warning to students. We have tried a number of different strategies for encouraging attendance in lectures and Inter-Act computer software in the laboratory. Providing 3 points for attending a class and additional 25 points for 25 hours of participation in the Inter-Act computer software laboratory in one semester have proven one way to keep the students interested. Another approach is to ensure that the lectures cover the same material as the textbook: but that they use different examples to illustrate important concepts. This keeps the students from concluding that they should just read the textbook instead of coming to lecture.

One painful problem we have encountered regularly when teaching a first year student basic mathematics course is that students think that they understand the material perfectly, but they are unable to solve problem on an exam. Typically these same students are so confident in their understanding on the material that they do not bother to turn in weekly homework assignments. They are shocked when they received a bad grade on the first exam. We have found that by scheduling four to six exams throughout the course of a semester and allowing students to drop their lowest exam score we can "wake up" students to basic problems in their understanding of the course material without making them feel that they cannot make up their bad start. In order to increase the effectiveness of this approach, we try to schedule the first exam fairly early in the semester. In this way, students can begin to improve their study skill and habit early in the semester and they will not be penalized by a low grade on their first test as it can be replaced by a higher grade on a later test.

IV. Summary and Conclusions

In this manuscript, we presented some of our philosophy and experiences related to teaching an introductory course in basic mathematics to first year students. Hopefully, our description of the "basic mathematics" course as taught at West LA Community College clearly demonstrates that by carefully selecting topics it is possible to teach an intellectually substantive course to entering students without making any assumptions about their background beyond simple algebra

and high school arithmetic. In summary, the focal points of our approach include: providing information in an experiential context; focusing on hierarchical decomposition as an approach to understanding complex real problems.

An important question is whether the course “Basic Mathematics”, as developed at West La Community College, would be appropriate for other institutions. Because it was intended for students with only a limited high school arithmetic background, we expect that this course should widely applicable at most colleges and universities. In fact, this course should also be appropriate as an advanced elective at some high schools.