The Role of Writing in a Second Year Course on "An Introduction to Applied Mathematics"

http://www4.ncsu.edu/eos/users/w/white/www/white/MA226.htm

by

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1. General Description and Objectives.

Applied mathematics at the undergraduate level is traditionally done after students have completed calculus, ordinary differential equation and matrix algebra. This means most applications are done in the senior year, and often this is without much reflection or preparation in the applied area. The overall goal of this second year course is early to expose students to a variety of applications so that the student is be able to determine an interesting applied area and to study the applied area in more depth.

Students are not ware of the scope of applied mathematics. This course has about five three-week modules in different areas of applied mathematics. Since the students did not have some of the required mathematics, the faculty members were challenged to develop the mathematics as was needed. Some traditional homework assignments were done, and the students wrote a one or two page summary of each module. At the end of the course the student did formulate and write a "Plan of Study" for their last two years. This could include traditional course work in math and sciences, intern positions, and any related activities.

2. Faculty Activities.

A number of different modules were proposed, and the ones selected had a mixture of application areas. Three-week modules in Spring of 2001were

Heat and pollutant transfer (R. E. White)
Acoustic waves and boundary conditions (H. T. Tran)
Cryptographic schemes (E. Stitzinger)
Biological applications (S. Lubkin)
Modeling of random phenomena (J-P. Fouque).

Since the only the third semester of calculus was assumed, the modules required faculty to develop some "math as needed" and the students to accept some "underdeveloped" mathematics. Many of the instructor's existing lecture notes and textbook materials were written for students who have had more mathematics. Therefore, the faculty had to either write some additional notes or do a lot of explaining of existing notes.

The faculty talked among each other concerning how the modules were progressing. One challenge is to get to know the students during a three-week module. Several remedies are (i) grade much more homework, (ii) use nametags, or (iii) put photos and other information on the www. Another challenge was to keep the modules from overlapping, and in particular, handing back homework from a previous module while the current module was in the initial stage.

The faculty reviewed all the "Plans of Study", and made either written or verbal remarks. Most felt the students did a nice job on these and indicated a willingness to teach this type of course in the future. Also, most faculty members acknowledged the need for more appropriate course materials.

3. Student Activities.

The students were did most of the traditional homework, wrote two page summaries of each module, and did thoughtful and well-prepared "Plans of Study". Students also did course evaluations. Some of the most common positive remarks were

(i). They enjoyed a variety of applied math and instructors.

(ii). The course really helps them plan for later studies.

(iii). The summaries at the end of each module were very helpful.

The most common negative comments were

(i). The grading was uncertain and chaotic.

(ii). The use of Matlab was new.

(iii). They would like a course packet written at a lower level.

Overall, I got the impression that they had very good experience that included an eye opening realization on the applicability of mathematics, and that the "Plan of Study" was very helpful.

4. Role of Writing.

The two-page summary of each module required the student's to indicate

(i). Like/dislikes about the module,

(ii). Relationship to other courses and

(iii). Content summary.

About a five page "Plan of Study" for the last two years. This required the student

(i). To focus on an area of applied math,

(ii). To formulate a list of relevant courses along with prerequisites, and

(iii). To identify any related activities such as work experience and "short" courses.

The students were encouraged to "interview" appropriate people and to report this in their "Plan of Study."

My impression was that the students enjoyed doing this because it was helping them to deal with many uncertainties such as career goals, lifetime contributions and roles, and choice of major areas of study. I personally unexpectedly found reading these to be a flashback to when I was twenty, which is quite some time ago.

5. Future of This Course.

This course will be described at a mini-symposium on computational science and engineering education at the annual meeting of the Society for Industrial and Applied Mathematics (SIAM). Here the application of mathematics is only one facet of the computational science mode of investigation, which couples applications with models, methods, computer implementations and overall assessment of the process. The overall assessment often requires good verbal and written communication skill, and it generally requires people to work with members of related disciplines.

The faculty will plan in August for the next version of this course in the spring of 2002. In order for this course to mature, course notes at appropriate levels will have to be written. Also, other modules should be developed so as to reflect the wide spectrum of applied mathematics and the faculty. Finally, the role this course is to play in our program will have to determined. Should it be a required course? Should it be linked in any formal way to advising? Can this course be useful to non-math majors who are interested in math? Can other disciplines benefit from a similar course and writing projects?

7. Appendixes

a. Course Announcement

b. A Module Outline

c. "A Plan of Study" Writing Project

d. One Student's "Plan of Study"

MA 293b
(Spring 2001, 1:30 to 2:20, MWF in HA 269)
A Second Year Course On

An Introduction to Applied Mathematics

http://www4.ncsu.edu/eos/users/w/white/www/white/ma226a.pdf

by

R. E. White (coordinator),
H. T. Tran, E. Stitzinger, S. Lubkin and J-P. Fouque

This new course will be a survey of applications of mathematics and will be suitable for students who have taken multivariable calculus. This second year course will enable the student to formulate a cohesive plan of study for the third and fourth year, which includes 15-27 elective credits related to applied mathematics.

This course will be useful to the student because it introduces in more depth additional applications. It will serves as a guide for future work such as the selection of a possible year course on applied math, selection of possible double major or honors program, identification of research groups, and identification of intern programs.

In the spring of 2001 there will be five three-week modules on

- Heat and pollutant transfer (R. E. White)
- Cryptographic schemes (E. Stitzinger)
- Acoustic waves and boundary conditions (H. T. Tran)
- Biological applications (S. Lubkin)
- Modeling of random phenomena (J-P. Fouque).

Each module will serve as motivation for future course work and related academic activities. Some mathematics will have to be developed "as is needed", but it is not necessary to fully describe the mathematical analysis related to the applications….this can wait for a subsequent course.

Each module will have some traditional homework assignments. The students will also be required to write a one or two page summary at the end of each module. These summaries will be used in the preparation of about a five page "Plan of Study for The Third and Fourth Years". This should include possible course work, prerequisites, faculty interviews, and related activities such as intern programs and employment opportunities.

Module of MA 226

Heat and Mass Transfer and Geometric (von Neumann) Series in $\mathbb{R}^n$

by
R. E. White

(draft date 06-013-00)

Module Objectives:

introduce diffusion and advection models

jump from $\mathbb{R}^1$ to $\mathbb{R}^n$ models

stability and convergence in $\mathbb{R}^n$

study $y^{k+1} = Ay^k + b$

Module Category:

differential equations and discrete models

Module Future Objectives:

could lead students to MA 401,2 or to MA 427,8
could lead to double major with CSC or PHY

Module Outline:

Lecture 1. Newton Cooling and Stability
Lecture 2. Discrete Versus Continuous Models
Lecture 3. Analysis of Discretization Error
Lecture 4. Diffusion in a Wire
Lecture 5. Analysis of Stability
Lecture 6. Diffusion in a Cooling Fin
Lecture 7. Pollutant Transfer in a Stream
Lecture 8. Pollutant Transfer in a Lake
Lecture 9. Analysis of von Neumann Series

Plan of Study Writing Project
for
MA 293b on Introduction to Applied Mathematics

This *Plan of Study* should be about five pages, and will account for 25% of your course grade. It should include possible courses that will form a *cohesive* set of applied mathematics. Here you may want to consult your two page summaries of the modules so as to identify an area of applied mathematics that is appealing to you. In order to formulate this *Plan of Study*, you should make sure of the content and prerequisites of the courses, which can depend who is teaching it. So, be sure to talk to the instructors and report your findings in the plan of study. You may also want to talk to any of us who have taught one of the modules. The *Plan of Study* can go beyond traditional course work, and may include internships, experience gained in part time jobs, short courses such as at the NC Supercomputing Center, and possible full time jobs upon graduation.

Ma 293b Into to Applied Math
"Plan of Study"
Student, 13 May 2001

Organizing the classes you are going to take in college is a really important thing to do. Many students try to take classes then realize they have not taken a different class that is a prerequisite. Often students realize this there senior year and some may not graduate on time because of not planning. Also planning each year allows one to decide when the best time to do other actives such as co-op, study abroad, or internships. Organizing your college career is a very important step each college student should take.

I am majoring in chemistry and applied mathematics on a five-year plan. After college I plan on being a cosmetic chemist. Since North Carolina State does not have a dermatology school, I am planning on studying at a college that has a good chemistry, mathematics, and dermatology program for one year. My fourth year seems to be the best year for me to go. However, I have not decided where I am going yet and therefore cannot decide what classes would be the best for me to take. This early in my career I am still taking the basic classes but I will need to decide by the end of next year where I am going and what classes I will be taking at that college. Planning ahead in this way will allow me to know what will be the best classes for me to take at this other school as to not get behind here at State.

Fall semester of my sophomore year I am taking CH221, Ma 341, Ma 225, PY 208, PE, MUS 150. The music class that I am taking is a vocal technique class. Since I am on a five-year plan that allows me to take classes that I have wanted to take. The spring semester of my sophomore year I am planning on taking the following: Ch223, Ch435, Ma 405, PE, Bus 225, and a history. The Bus 225 is a personal finance class.

The fall semester of the junior year I will be taking the following classes: Ch 431, Ch 211, Ch 212, St 371, Eng 112, ANS 303. The animal science class is an equine science class that I have wanted to take. I am planning on taking this class as of now however if my workload is too much I will drop this class from my schedule. Since I would like to own horses in the future this class would be very beneficial to me. The spring semester of this year I am planning on taking the following classes: Ch428, CSCll2, EC201, St372, SOC 301.

My senior year is the year I am planning on studying somewhere other than North Carolina State. I plan on finding a college that has a good chemistry and mathematics program so that I can take the following courses: Ch 401, Ch402, Ma407, Ma425, and a dermatology class. Second semester I am planning on taking Ch403, Ma426, and two dermatology classes. This schedule may change due to what I need to take while I am there and how good their other programs are.

The first semester of my fifth year I am planning on taking Ch435, Ch 415, Ch416, Ma427, and a literature class. The second semester I am taking Ch434, Ma428, a math modeling class, and Soc 301. This last semester I only have 12 hours, which will allow me some extra room in case there is a class that I either want to take or that I need to take.

After I finish my undergraduate degree in Chemistry and Applied Mathematics I am planning on going to graduate school. I thought that it would be easier to continue school and get a graduate degree rather than to come back later. I am planning on getting a graduate degree in Chemistry. I think I will then decide to get a job and then later if I decide to further my education I will do so at the time.

I am taking the basic classes that I need to take throughout college. There are a few courses that I have decided to add as extra classes because I have wanted to take them. The year that I am going to go to another school is going to be a very important year for me. Dermatology is a very important field of study for my career. I am very excited about this year. Planning out the future of my college career has not only allowed me to be sure that I have all the classes that I need but also allowed me to decide what would be the best time for me to explore another college. The organization of my college career has helped me a lot and will be very beneficial to me in the future.