

Creating an Effective Environment for Learning SAS® Programming Online

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ABSTRACT

Knowledge of SAS® programming provides excellent employment prospects in a variety of industries and can lead to a challenging and rewarding career. However, learning the SAS programming language can be daunting, especially when undertaken alongside a full time job and family obligations. This paper will discuss the author's experience in developing and delivering effective online SAS programming courses and present strategies and ideas to promote successful learning and knowledge transfer when teaching a diverse student population of working professionals.

INTRODUCTION

I have been an instructor for both traditional classroom and online courses at the University of California, San Diego, Extension Division for over 15 years. My teaching experience at UCSD Extension began with the development and teaching of a traditional hands-on introductory SAS programming class. This was a three unit course taught one night per week for three hours with nine class meetings. It was a highly interactive course. My lectures generally consisted of a short overview and discussion of a topic followed by running some example SAS code to illustrate the concepts. Each student was seated at a computer and could access the lecture code and data at the same time. Based upon student questions (or puzzled faces), I would create new examples or modify the code to answer questions and mostly resolve the bewilderment. Grades were based upon a weekly short programming assignment, a comprehensive programming assignment due on the last day of the course, and class participation.

Several years later, I became involved in online learning when I assumed the teaching responsibilities of statistics courses that had been developed by other instructors. While much effort had been expended on the development of these course materials, the content and structure was consistent with that of a traditional classroom course and did not utilize or take advantage of the technology inherent in a web based course. The course material consisted of textbook reading and weekly lectures in PowerPoint slide format without audio. However, it must be noted that this was the lecture format used at that time by UCSD Extension. There was also a weekly assignment of a single statistics problem; students were required to type up the solution and email it to the instructor. Students completed evaluation forms at the end of the course and comments regarding these courses were somewhat negative. Most students felt that these were essentially self-study courses and commented that there was little interaction with the instructor and no interaction with classmates. After doing some research on developing effective online courses, I began to make changes to these courses and completely redeveloped the course content. The weekly assignment was replaced with a weekly multiple choice quiz which was graded immediately upon submission. To facilitate interaction between students, each student was assigned to a small group of 4-6 students and each group was required to analyze some data and prepare a report on the analysis and findings. Once these changes were implemented, student evaluation comments and the overall recommendation of the courses became positive.

Once I became an online course instructor, administrators at UCSD Extension encouraged me to convert my SAS programming course into an online course. The need for an online

course became apparent when administrators and I discussed the idea of developing a specialized certificate program in Biostatistics which would be offered completely online with my SAS programming course to be one of the required courses in the program. I developed my course into an online format and began teaching it online in 2009 when the Biostatistics certificate program was launched. With the success of this certificate program, numerous students began inquiring about an online SAS Programming certificate. Once an advisory committee of industry leaders was formed to develop the curriculum and instructors were identified for teaching the courses, the SAS Programming certificate became reality in 2014.

The SAS Programming certificate program consists of six courses. There are two foundation courses, SAS Programming I: DATA Step and PROC Fundamentals and SAS Programming II: Advanced DATA Step Programming, three specialized courses, SAS SQL Programming, SAS Macro Programming, and Output Delivery System and Data Visualization Essentials using SAS. The final course is the SAS Programming Capstone Project. In this course, students are paired with a mentor. Working with the mentor, the student defines a topic of interest, finds or generates relevant data and uses SAS to demonstrate knowledge of programming techniques and/or data analysis, and writes a technical paper which discusses the associated programming concepts and methodology used in their analyses. The mentors are SAS experts and experienced presenters at SAS User Group conferences and assist students in preparing a paper which can be presented to a potential employer as evidence of SAS knowledge and skills or potentially submitted for presentation at a professional conference. I am currently the instructor for two of these courses, SAS Programming I: DATA Step and PROC Fundamentals and the SAS Programming Capstone Project. Most of this paper will focus on my experience in developing and teaching the SAS Programming I course.

OVERVIEW OF THE VIRTUAL LEARNING ENVIRONMENT

Online courses at UCSD Extension are taught through a web based system called Blackboard Academic Suite. Course material is organized using the various pre-defined pages - Announcements, Introduction, Syllabus, Lessons, Discussion Board, Assignments, and Resources - available within the course shell. There are a few required elements for some of the pages, but an instructor also has the flexibility to add additional items and materials to each page. The content of most of these pages is self-explanatory. The Discussion Board is an area where all course participants may post text for everyone to read and respond, similar to a bulletin board. I use the Resources page to provide links to SAS related websites of interest.

From within the course shell, the instructor and students can send email which is delivered to external email accounts. Grades are recorded in an online grade book and students can view their grades for each assignment during the course. Other features available to instructors include the ability to see when students last logged in to the system and what parts of the course have been accessed by each student.

SAS SOFTWARE ACCESS AND TECHNICAL CONSIDERATIONS

SAS® ONDEMAND FOR ACADEMICS: ENTERPRISE GUIDE

Students enrolled in the course are required to use SAS® OnDemand for Academics: Enterprise Guide, a product which provides an online delivery model by connecting to a SAS-hosted server over the web. This requirement is included in the course description on the UCSD Extension website along with a link to the SAS® OnDemand for Academics page on the SAS website which provides the hardware and software requirements for product installation. Potential students can then determine if they have adequate computer resources before enrolling in the course.

I require the use of SAS® OnDemand for Academics: Enterprise Guide for several reasons. The product is free so there is no additional financial burden on students beyond the cost of the course. Since this is an introductory course, I want all students running the same version of SAS on the same platform. This prevents unexpected issues, errors, and results due to the use of older or newer software versions or operating system differences.

As the instructor, I registered the class through an application on the SAS web site, providing administrative information such as course title and section number. Unless I want to add or change files on the server, there is no further maintenance that is required from me from course session to course session.

INSTALLATION AND TECHNICAL SUPPORT

Students register for the course license on the SAS website. Once they have registered, they receive an email with instructions for downloading and installing the software. When the application is started, a username and password is required to connect to the remote SAS server. Students are able to use the software beyond the length of the course. Employees at SAS have told me that as long as a student account continues to be used, the account will remain active. Only those accounts that show no activity after a year or more are purged.

The vast majority of students have no problems downloading and installing the SAS software. Since I started using the product in 2009, the number of students who do encounter problems has significantly decreased over time. I would estimate that installation issues currently affect only about one or two percent of the students. Over the past few years, installation issues seem to entail a hardware or software conflict with the SAS software that is very specific to that user's machine. I am unable to help students resolve these types of problems and they must contact SAS Tech Support for assistance.

SERVER AND OPERATING SYSTEM

The server used for SAS OnDemand for Academics uses the UNIX operating system. For students unfamiliar with UNIX, this has caused some confusion when writing libname or filename statements. Common problems include the use of the forward slash '/' rather than the backward slash '\' and the desire to add a drive letter at the beginning of the pathname.

Once a course is registered or defined in the SAS OnDemand for Academics Control Center by the instructor, a directory for that course is created on the server and data files and data sets can be uploaded. Only data files or data sets may be uploaded to the server. Other files such as SAS program code, course notes, and documents cannot be stored or accessed there.

Only the instructor has write permission to the course directory. This is advantageous because it ensures that students cannot accidentally overwrite permanent data sets that are used by all students. Additionally, having all students access the data in exactly the same place does provide an advantage to me because if I wish to run code submitted by students on homework assignments or code sent to me by email, I do not need to change libref or infile statements.

In the SAS session, data on local drives cannot be accessed. Only data sets and data files that are stored on the server can be accessed in filename and libref statements. But SAS code in a file must be included from and saved to a local drive. This causes confusion amongst some students. Many assume that since they must access the local drive for their code files that SAS OnDemand can also access data files and data sets stored in these local directories.

COURSE DEVELOPMENT AND ADMINISTRATION

COURSE DESIGN

UCSD Extension offers professional studies courses and the vast majority of students enroll to upgrade professional skills rather than using these classes to fulfill requirements for a degree. For many people, this will be the only class in SAS programming they will ever take, so at the end of the nine week course, I want students to leave the class feeling like they have adequate knowledge and skills to effectively use SAS on their own. With this in mind, I have tried to design an introductory SAS programming class that provides a solid foundation in Base SAS elements, specifically, use of the DATA step and elementary PROCs. I have also tried to implement policies and procedures that adequately accommodate a wide variety of skill levels, learning styles, and even time constraints.

In designing my SAS Programming I: DATA Step and PROC Fundamentals online course, I have maintained the same syllabus, assignments and grading criteria as I had used in my traditional course. There is a weekly lecture delivered via Adobe Presenter and all lectures are available to students during the entire course. In the initial offerings of the online course, I could see what was working well or not based on student questions as well as comments provided on the anonymous course evaluation survey at the end of the course. Most of these issues were easily addressed by providing additional material or resources on certain topics, rewriting text for clarity, or updating links to external web sites.

ASSIGNMENTS

Assignments are made available on a rolling basis during the course. Since the course is not self-paced, this keeps students more engaged by working on the same material at the same time. Additionally, students who are struggling often become more apprehensive when they see other students posting questions on material presented in a much later week of the course than the current week of the course. Students who need to work ahead due to work commitments or travel may contact me and I provide any needed assignments to them in advance of their absence.

There is one assignment due each week on the same day of the week. The assignment is either a discussion topic or a programming assignment. The discussion topics require short answers or a paragraph of a few sentences and should take no more than an hour to research and prepare an adequate response.

A comprehensive programming assignment makes up ninety percent of the course grade. Some important aspects of the assignment include reading in data from external files and permanent data sets, merging data sets, creating new variables, working with dates, using assignment statements and functions, applying labels and formats, and generating data sets and output from PROCs. The assignment is completed in three large pieces and each subsequent piece is dependent upon successful completion of the previous portion.

Some students find the programming assignment to be quite difficult, but I believe making it easier would detract from the course. Easier assignments do not meet the needs of more advanced students and, in past courses, have generated complaints in the course evaluation comments. Easier assignments also do not generate as many questions which reduces student interaction and participation in the class. To help students, I provide a programming template which presents an outline of the code or appropriate programming element to be used in each problem on the assignment. Students are free to choose whether they use the template or not. By the end of the course, most students come to the realization that they have an excellent understanding of how all the individual pieces fit together in a cohesive program because of the programming assignment which reinforces my belief that I should not simplify it.

SUCCESSFUL LEARNING IN THE ONLINE COURSE ENVIRONMENT

WRITTEN MATERIAL AND RESOURCES

In an online course, students rely solely on written material so instructions and explanations must be specific and detail oriented. The course material is static and this has its advantages and disadvantages. The lectures can be reviewed by replaying them. But precisely because the material is static, online courses can also be more frustrating to some students when they encounter problems or concepts that they have difficulty understanding. I know that providing a different explanation sometimes clarifies the issue, so I try to provide students with alternative online sources (such as the SAS Online Documentation or papers presented at SAS conferences) where they might find the same information presented in a slightly different way.

COMMUNICATION AND INTERACTION WITH COURSE PARTICIPANTS

Students usually feel much more isolated and disconnected from their instructor and classmates in online courses. To address this issue, I incorporate and promote the use of the Discussion Board in my courses. The Discussion Board is an area where all course participants may post text for everyone to read, thus simulating a class discussion to some extent. In the Discussion Board, the instructor has the ability to create categories called forums and both students and the instructor can create subcategories called threads underneath these forums.

Another way in which I have attempted to encourage student interaction is by allowing group submission of programming assignments. Students who wish to work together submit a single assignment and all group members receive the same grade. Learning is facilitated when students work together because they can help each other understand the material. From a grading standpoint, the collaborative efforts usually result in a better quality assignment submission and reduces the number of assignments that I must grade.

DISCUSSION BOARD ASSIGNMENTS

To familiarize students with the Discussion Board, I have students complete an assignment in which they post an introduction about themselves during the first week of the class. They are asked to comment on their occupation, knowledge of any programming languages, reasons for taking the course, and geographic location. While most students probably believe this is just an easy assignment, it often provides me with some useful insight into student performance during the course. Students struggle in this class for many reasons and knowing something about their background helps me to better understand and respond to their issues. The question about geographic location often helps not just me, but other students in the class who may be interested in forming virtual study groups in their time zone or to those who want to form study groups that meet physically.

In subsequent weeks, I post "thought questions" on the Discussion Board. These are mostly questions which do not have right or wrong answers, rather, they are meant to allow students to think about concepts like missing values and various programming issues such as program errors that they may encounter while writing SAS programs.

Once I post these topics, students write up and post responses both to my initial posting and comments left by other students. In my experience, most students write up a response and simply post it to complete the assignment. Only a few take the time to comment upon others' responses, so it is not quite the same as a classroom discussion. However, because students have time to read and reflect upon the questions, responses tend to be more thoughtful than those received in a spur of the moment in-class discussion. In course evaluation comments, some students have noted that they felt more engaged than by a

traditional in-class discussion simply because they are not quick thinkers and preferred having more time to develop a response. After the due date for each topic, I post my own thoughts about the topics and point out any particularly good student responses.

CLASS DISCUSSION FORUM

In my courses, I have a Class Discussion forum which promotes interaction and helps to make the class feel more like a traditional in-person class. Students can use this forum to post comments and questions or share useful or helpful information such as links to external web sites. Questions related to the course material must be posted in this forum rather than emailing those questions to me. The use of email is reserved for issues of a personal or administrative nature. There are several reasons for this policy. When questions are emailed to me, only the student who sent the message sees the response, so often I end up answering the same question multiple times. Posting the questions and answers in Class Discussion forum enables me to answer questions once and all students can benefit from the discussion. Another advantage to posting questions in the forum is that other students who can answer those questions may be able to see them and post responses before I do. I review student responses and provide any needed corrections or further elaboration. I believe it is most important to acknowledge and thank students who attempt to answer questions, even if the answer is incorrect because it fosters a welcoming environment for learning. Finally, posting questions in a public area causes students to think a bit more about what they are posting and prevents an endless cycle of email with question after question.

The programming assignments generate so many questions and appeals for help that I create threads for each assignment item in the Class Discussion forum. Doing this keeps the questions on that item grouped together, reduces redundant questions, and helps everyone to find things more easily. Students may ask questions about the assignment item or post code and ask for help to resolve issues. Many times, the solutions are posted and discussed before the assignment is due. I feel this is acceptable because the in-depth discussion of the solution promotes additional learning and understanding. Additionally, incorrect code sometimes has the effect of generating even more interesting discussions that would have never taken place otherwise.

Students tend to divide themselves into two distinct groups, those who participate in the Class Discussion forum and those who do not. The latter group tend to be students who find the course less challenging and prefer to simply complete and submit the assignments by themselves. To discourage this behavior and encourage participation, I award bonus points at the end of the course to students who participate in the Class Discussion forum.

CONCLUSION

Online courses make learning more accessible and provide more freedom and flexibility to both the student and the instructor. To be successful, a student must not underestimate the amount of time needed to master the material in an introductory SAS programming class which many find to be difficult and technically challenging. In turn, a good instructor for such a course needs to create a welcoming environment for learning, promote active participation and communication, adapt course content to accommodate a variety of skill levels and learning styles, and provide additional resources beyond what would normally be found in a traditional class. Online classes have been shown to be as effective as or more effective for learning than traditional courses. Online learning is not for everyone, but for those who are motivated self-reliant problem solvers with good time management skills, online classes can provide a great environment for learning.

REFERENCES

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