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ABSTRACT

Although most schools offer and/or require a course in spreadsheet and database applications, the amount of meaningful learning derived from the class varies widely. The approach described in this paper involves a combination of demonstration and hands-on practice using two term-long cases to be used in an introductory course in spreadsheet and database applications. These cases, packaged together with slides emphasizing theory, hands-on quizzes and exams that foster critical thinking, can be used across the multiple sections that are taught to maintain consistency within the course and encourage faculty and students to take the course to a higher level. Evidence based on final exam scores indicates that students are achieving the higher level of understanding that is the intent of this method of teaching.

Keywords

Excel, Access, Student Retention, Learning

INTRODUCTION

Spreadsheet and database application skills are increasingly being required both in MIS programs and in Colleges of Business. A perusal of the syllabi on the ISWorld site (http://www.magal.com/iswn/teaching/intromis/), as well as discussions with colleagues who teach the course, indicates that these skills are frequently taught in an introductory MIS course. Other schools teach these skills in a dedicated applications course. These courses are either designed as 3-4 credit courses where all Office applications, as well as an introduction to the Internet are covered, or, in many cases, as 1 or 2 credit courses that teach a subset of the applications.

Regardless of the course structure, the time available to teach the individual applications is usually short. In many schools adjunct faculty teach the courses. They use very detailed, step-by-step, textbooks. Anecdotal evidence indicates that many times the process of teaching these courses involves the instructor putting together a list of exercises from the end of chapter material and allowing the students to work on the exercises during a lab session. The student exercises generally involve modifying a worksheet or database that has been partially completed. Very little effort is placed on teaching spreadsheet or database theory or explaining why something is done a particular way. Students become adept at following instructions and mimicking the finished product. However, they do not know how to design a spreadsheet or database, whether to use a pie chart or bar chart, and under what circumstances to use a VLookup rather than an IF statement. They become technically proficient during the course but have not learned how to act independently. Down the road, when they are required to use Excel in an accounting class or Access in a database class, they are unable to make the leap to abstract thinking, not to mention that they have forgotten the specific "how-tos" of creating a chart or using a function.

LEARNING BY DOING

Textbooks for teaching spreadsheet and database applications generally include detailed chapter text that explains how and why to use many of the facilities of the software. They also include hands-on step-by-step instructions explaining how to implement the functionality. The idea is that students will learn better if they actually work with the application (Satzinger and Olfman 1998). Unfortunately, most of the students do not read this detailed text, thus do not benefit from this thorough approach. Based on an informal survey of students in my courses, roughly 25% of the students will have had no exposure to spreadsheet or database applications, roughly 50% have come into the course with a foundation in spreadsheet techniques learned in a high school class and 25% of the class will be fairly proficient in spreadsheets and have had some exposure to databases. This paper proposes a method of teaching the course so that everyone leaves with a broader knowledge base than they started with.

In addition to the diversity of the students, as well as their propensity to ignore the readings, several issues also arise with the end-of-chapter materials. First, as stated earlier, the exercises frequently start with a template that simply needs to be modified. The rationale for this approach is two-fold. The student does not have to spend a lot of time "typing", i.e. creating row headers and column headers. And, the student does not have to worry about how things are laid out; the design has been done for them. The second issue associated with the end-of-chapter materials relates to the necessity on the student's part to "learn the environment" with every new exercise. Each exercise has its own problem domain. As the domain changes, the student is forced to orient him or herself to a new environment. In one exercise they may be required to complete a payroll worksheet, in another one it might be an exercise to compute the amount of interest that would be paid over the life of a loan. There is no continuity between the exercises and each exercise is a stand-alone entity designed to teach a specific skill.

According to Johnson (1996), students retain 10 percent of what they read, 26 percent of what they hear, 30 percent of what they see, 50 percent of what they see and hear, 70 percent of what they discuss with others, 80 percent of personal experience, 90 percent of what they say as they do it, and 95 percent of what they teach. Thus, it stands to reason that hands-on use of the software applications would improve learning and retention. However, the process of following instructions rarely encourages students to interact with each other. In addition, there is no personal experience involved when the student is simply mimicking something put before them. Critical thinking skills can be encouraged by using a case-based approach to teach the content of the course. Case-based teaching has long been used in business schools (Barnes, et al. 1994, Booth, et al. 2000, Jennings 1996). The cases used in many disciplines, such as accounting, finance or management, typically consist of a narrative describing the environment of the case and then the actual situation to be addressed. This is generally followed by a set of questions to be addressed by the student. Cases involving spreadsheets have been used to teach concepts such as statistics (Parr and Smith 1998). These cases can be structured as narratives describing the situation and then asking students to apply specific statistical techniques within the given scenario. The assumption when using a spreadsheet case to teach statistics is that the student is already familiar with the tool. Can we apply the principles of case-based learning in teaching the tool itself?

Reimann and Neubert (2000) explore some of the issues associated with learning a new application. Overall, they argue that students learn best when several conditions are met. First, learning tends to occur best when there is a specific problem to be solved. Second, learning occurs more effectively when there is an example to be followed (Chi, et al. 1989, Pirolli and Anderson 1985, Satzinger and Olfman 1998). Finally, the role of self-explanation in learning is critical. The student must articulate what he or she is seeing and how it pertains to what they are trying to accomplish. Reimann and Neubert's work deals specifically with learning to use a spreadsheet. However, it would seem the principles can be applied to learning database applications. The case-based approach could aid in meeting some of the goals identified by Reimann and Neubert as crucial to learning a new application.

THE CASE-BASED APPROACH

The issues discussed in the previous section have all been faced in teaching a two-credit course in Excel and Access at our school. In an effort to improve consistency among adjunct faculty teaching the spreadsheet and database course, as well as improve student retention of the principles of spreadsheets and databases, a package was developed that would ultimately be available to all adjunct faculty teaching the course. This package, which consisted of a set of folders on a CD, included the following:

- A demonstration case (The Car Case)
- A homework case (The Fruit Stand Case)
- A set of annotated PowerPoint slides emphasizing spreadsheet and database theory
- A set of hands-on quizzes tied to the principles covered in the two cases
- Midterm and final exams (The Bag Lunch Case)

In addition to the package of materials a weekly lesson plan was proposed. The structure of a given class was to go over the previous week's homework, give a 15-minute quiz, discuss the theory of new subject material and demonstrate new techniques using the demonstration case. If there was time left over, they could use the time to begin the next week's homework. Our classes are 1 hour and 50 minutes. Students typically had 5 – 25 minutes of lab time, depending on the complexity of the material to be covered.

The two cases are on-going cases that build from day one through the end of the course. The same case is used for spreadsheets and databases, thus helping the students to understand the role that each application can play in solving business problems. The slides are designed to encourage the instructor to cover the theory, as well as the technique. Quizzes are similar in style to the homework and test the functionality covered in the homework. In general, quizzes are not based on terminology, but rather on how to apply the skills in new ways. Each of these pieces of the overall package will now be described in greater detail.

This course is taught without a specific textbook. The students are encouraged to purchase a generic reference book that they will be able to use in future classes. The first time the course was taught, a "Dummies"-style book was suggested for students who felt that they had no background in the application. However, the techniques included in the cases quickly went beyond these books so it is now recommended that students purchase complete references books for Excel and Access, such as those put out by Que or Osbourne.

The Demonstration Case

It is frequently the case that students taking this course are from diverse majors. At our school, the course is a requirement for all freshmen in all business disciplines. Thus, the student population, in addition to being diverse in skill levels, is also diverse in interests and backgrounds. In an attempt to address all students from a common base, it was decided that the demonstration case would track gas purchases for a car. By necessity the case was somewhat contrived. By the conclusion of the course the students had an Access application that tracked multiple drivers with multiple vehicles. Both gas purchases and maintenance items were tracked. It is unlikely that a student would ever need this level of detail. However, the case started in week one with simple formulas for calculating miles per gallon and miles traveled between fill-ups. The students could relate to these numbers. By the time we got to the end of the course, students had been building the application, piece by piece, over the course of the term. They didn't have to "relearn" the environment each week, and had few problems with the complexity of the solution at the end of the term. They were able to focus weekly on learning new techniques to improve their application, and were rewarded with the difference between the work on the first day of class and the last day of class.

The components of the package pertaining to the Car Case were:

- Instructor instructions
- Student instructions
- Solutions
- Starting files

The instructor instructions are very detailed, giving the instructor not only step-by-step instructions for completing each task, but also areas to emphasize to further student understanding. For example, a task that involves creating a line chart showing the price per gallon of gas over the time that it has been tracked would include the specific instructions for how to create the chart. It would also include trouble shooting hints for the students such as previewing the chart and if it doesn't look the way they expected it, try clicking on rows rather than columns or vice versa. Finally, it will have specific reminders for the instructor that ties the theoretical slides into the practical application. It will remind the instructor to go over why a line chart would be appropriate in this instance, but a pie chart would not.

The class is taught in a lab and students are encouraged to work along with the instructor. This works well for some students and doesn't work at all for others. Students who have a foundation in the application and know where things are can usually keep up. Those that are still struggling with basic concepts such as formulas and cell references may find it more efficient to watch the demonstration and go back over it again on their own. The student instructions are provided for this occasion. Student instructions provide step-by-step commands in much the same way that the current textbooks provide guidance within the text of the chapter. However, there are no screen shots, and the students will have seen it demonstrated before they need to attempt it on their own. The instructor commentary is also omitted from the student instructions. The goal of the student instructions is simply to provide guidance for students who need to go over the work multiple times.

They also receive a short tutorial on how to use a reference book. Many of the students depend on the help function or Internet resources rather than purchasing a reference book. It would appear however, that students who do purchase (and use!) the reference book are the ones that get the most out of the class. Based on follow-up comments from a database class, the text that is frequently used in these courses is insufficient to use as a reference book when completing database projects. Thus, introducing the use of a reference book early in their schooling is beneficial in multiple ways. It helps them to get used to the idea of using a reference book, and provides them a more complete resource for later classes.

The solutions and starting files are actually the same file in different folders of the CD directory given to the adjunct. The solution to week one becomes the starting file for week two. They are organized in separate folders to make it easier for the adjunct instructor. The students will be provided with both files. Thus, they can use the starting file to follow the instructions and then compare it to the completed file.

The Homework Case

With the same rationale that was used to develop the Car Case, the homework case is called the Fruit Stand Case. The students track the sales of fruit for a small fruit stand and ultimately produce invoices from an Access database. Although this might be construed as an accounting exercise, all of the students have purchased things and most of have them have seen a receipt or invoice with extensions and tax calculations. It is sufficiently different from the Car Case that they are not simply redoing the work that was demonstrated in class. However, the techniques that are demonstrated will be used in the homework. If we discussed absolute and relative cell referencing in class, that technique will be used in the Fruit Stand Case. When we create a form in Access for the Car Case using a wizard and then modify it in design view, the same technique will be used to create a different form for the Fruit Stand.

As with the Car Case, starting files and solutions files are the same. The starting file for week two is the solution file for week one. Unlike the Car Case, students are not provided the starting file for week two until after they have turned in the homework for week one. Starting from week two they are working with a template. This keeps students on the same track. Each homework assignment differs dramatically among students. If they went forward with their own files they might not be able to implement the specific instructions in subsequent assignments. Thus, the final product of their work all looks very similar. The downside to this approach is that they are working from templates. However, they had to have put some thought into the solution before they are provided with it so it is not the same as being provided with a template that they didn't help design.

PowerPoint Slides

The emphasis with this approach is that students will understand why they are performing specific tasks, as well as how to choose between available options for performing the same tasks. The slides serve two purposes. They provide the rationale and essential spreadsheet and database theory. In addition, for specific tasks that are taught, many of the step-by-step instructions are included in the slides. Thus, they are an additional resource for the student to come back to when working on the homework.

Because many adjunct instructors for this course are technically proficient, but self-taught, they may lack the ability to put the theory into words. The instructor set of slides provides annotation, in much the same way that the instructor instructions for the Car Case are annotated. They provide examples and areas to emphasize. They take the burden of having to "lecture" off of the instructor and instead provide a framework within which the instructor can intertwine his or her own experiences.

Quizzes

Homework is not graded in this class. Students receive a check if they turn it in, nothing if they don't turn it in. My experience has been that some students will do the homework and allow others to turn it in as their own. Obviously, this only harms the student who doesn't do the work, but it is a waste of time to grade duplicate homework. The resolution to this problem is to have a quiz after each homework assignment. Unlike the Car Case and Fruit Stand Case, which are very dissimilar, the quiz is closely tied to the homework. Students who have completed the homework will generally do well on the quiz. Those who didn't do the homework will generally not do as well. As stated earlier, the structure of the class is to go over the homework before giving the quiz. Time spent on going over it is usually about 10 minutes.. Thus, students who did not do the homework will not benefit from this. Those that struggled with it can at least see where their mistakes occurred and will generally do better on the quiz. They do not have access to the solution (or the starting file for the next week) until after the quiz is completed. All quizzes are open notes so this benefits the student who has done the homework.

All of the quizzes are hands-on except for the quiz following the initial database lecture. An entire class is devoted to discussing topics such as entities, attributes, records and keys. Without this fundamental understanding of what a database is the students cannot go beyond a one-table database. If restricted to one table, then the concepts of forms and sub-forms or grouped reports cannot be illustrated. Thus, this quiz is a multiple-choice quiz on database terminology and concepts. The homework that is assigned after this first database lecture is to brainstorm the tables that would be in the Fruit Stand Case. This is a very difficult assignment and very few students are able to do it. However, to reward those students who attempt the assignment they are given credit on the quiz for the homework- whether they get it right or not.

Exams

The midterm and final exams are another case, similar in functionality to the Fruit Stand Case. The Bag Lunch Case involves developing invoices for bag lunches that are distributed to hikers in the local hiking club. In addition to the invoices, they must total up all sales and generate a grocery list based on some purchasing rules. Finally, they graph the invoice totals to look at trends and determine if hikers should be individually charged for their lunches or if one amount can be charged for dues for everyone in the club. The midterm exam uses only Excel. The final exam uses both Access and Excel., thus it is a cumulative final.

A practice exam is distributed up to a week prior to the exam. The actual exam is essentially the same as the practice exam with different data. The exams are very long and include applications of the techniques in ways that are different from those demonstrated in the Car Case or Fruit Stand Case. There are several tasks that involve critical thinking skills. Students are encouraged to practice the exam prior to the time it is taken in class. A significant goal of this class is to encourage problem solving skills. In order to achieve this goal, the students need time to analyze the case and work out the solution. An exam should be a learning experience, not simply an opportunity to regurgitate memorized facts. The exams are designed to facilitate additional learning.

The exam itself is given during a regular class session. The students are provided with a starting file that has information embedded in it to deter cheating. For example, if it is an Excel file, then I will put the name of the class and the date and time in cell A500. The students are not likely to find it, but I always check it to make sure they start with the official file. As stated earlier, the data for the actual exam is always changed from the practice exam. This also helps to deter cheating. They are not allowed to bring files into the exam. The exam is designed to be completed in approximately one hour if the students have practiced it. Those who haven't practiced it rarely finish the exam.

CONCLUSION

The actual skills that are covered in an introductory spreadsheet or database course are only a fraction of what the student should be taking out of the class. The likelihood that they will remember exactly how to do a VLookup or calculated control two years after taking the course when they first need to use it in Accounting or Database Management Systems is very small. The version of the software they must use two years later may not be the same version that they learned on. Students need to be able to get to a level of meaningful learning in the introductory course so that they will have the tools to *find out* how to do things, not necessarily *remember* how to do them. Students need to understand what spreadsheets and databases are used for. They need to know when to choose one over the other. Within each application, they need to determine what functionality should be used to accomplish specific tasks. And, most importantly, they need to know how to find out how to accomplish specific tasks. In order to reach this level of meaningful learning, I suggest that a case-based approach to teaching the class is very effective. A demonstration case, along with a homework case, coupled with slides to emphasize theory and a collection of quizzes and hands-on practical exams, can allow this course to be taught at a level so that the end product is a full application.

Student feedback from this approach has been favorable. The approximately 75% of students who come into this course with some knowledge of spreadsheets and/or databases find that they really increase their knowledge base. The other 25% of the students struggle with the material, but will master it if they spend enough time on it. Interestingly, the grade distribution for the course is very bi-modal. The second time the course material was used, two different full time faculty members taught a total of three sections. The overall GPA was 2.89, with a significant number of A's and B's. The number of F's was also substantial. The final exam is a difficult one, and involves skills in forms and sub forms, calculated controls, report groups and queries with complex calculations, as well as exporting the data to an Excel spreadsheet for further analysis. It is the opinion of several faculty who have evaluated the exam that students who do well on the exam have achieved a very high level of learning. In coordination with Accounting and Finance faculty at the school, we intend to follow-up the study in two years to gauge how well the students are able to perform in accounting, finance and MIS courses.

The single biggest criticism of the course is that it goes too fast. The demonstration case is geared for the 75%, not the 25%. Thus, students who do not have a basic foundation sometimes cannot keep up with the demonstration. However, the resources are available to get these students up to speed quickly if they are willing to put in the time. Students like the continuity of the cases although some find the Car Case contrived. They like the fact that the techniques are reinforced with homework and quizzes, as well as the exams.

The course is currently being taught by an adjunct instructor. At the mid-point of the quarter students continue to perform well and the average on the mid-term exam was 88%. The instructor, in an effort to give the students additional help, posted a partial answer key prior to the exam. It is unclear whether or not it was sufficient to allow the students to "memorize" the

answer. Regardless, it has been decided that no partial answers will be made available for the final exam. Students have the option of instructor help during the practice period and, as stated earlier, a primary goal of the exams is to foster critical thinking skills. Providing partial solutions prevents the students from designing their own work.

From a pedagogical point of view, the opportunity to provide a consistent course to all students, regardless of who teaches it, is extremely attractive. An "A" in Instructor Smith's class will be the same thing as an "A" in Instructor Jones' class. Only a handful of specific functions are taught, but the finance major will know enough about how to use a function that they will be able to apply it to the finance analysis and the marketing major will be able to apply it to a marketing analysis. All students will be able to use a reference book- in effect they are "learning how to learn." And that is the ultimate goal of going to college in the first place.

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