Concept Matrix Approach to Teaching Management Information Systems

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ABSTRACT

The purpose of this study was twofold. One, to experiment in the classroom with different note taking methods that hopefully would allow students to better synthesize the material presented in an introductory management information systems course. And two, to reinvigorate the instructor after teaching the introductory management information systems course for about twenty years. Students in two sections of an introductory management information systems course received instructions on using mind mapping, concept matrices, and adding notes to power point lectures. Then each class voted as to their preferred method of note taking. One section selected adding notes to power point lectures and the other section selected concept matrices. The students were given pre and post tests over the course content. The results of this small exploratory study showed minimal impact from the change in instruction methodology. Anecdotally, the students liked learning about the different approaches and used them in other settings.

INTRODUCTION

This study began when the author was involved in a reading group sponsored by the faculty development center. The group read Maryellen Weimer's book: *Learner-Centered Teaching* (2002). In a discussion on developing independent learners, the idea of using concept maps and concept matrices to help the learner categorize content for better understanding was briefly mentioned (p. 172). This sparked the author's interest and curiosity, which led to researching concept maps and matrices use in the classroom. The research evolved into an exploratory study that experimented with different note taking methodologies and used two sections of an introductory management information systems (MIS) course. These classes meet in a computer lab where each student is at a workstation. It can be frustrating teaching in a lab environment when you know that many of the students are checking email, playing games, surfing the Internet or doing other work. Keeping the student's attention during class is not a unique situation to introductory MIS courses. In John Schwartz's article, "Professors Vie With Web for Class's Attention" in *The New York Times*, (2003) he stated that "professors say the technology poses a growing challenge for them: retaining their students' attention." Most teachers know that distraction is not new; however, the computer technology now gives the student access to greater time wasters, at least from the teacher's perspective. Professor Mallek at American University said "As a professor if you are not productively engaging them, they have other opportunities" (Schwartz, 2003). Therefore, finding an activity that required the students to use the computer during lectures would be beneficial to the students' learning process and hopefully less frustrating to the instructor.

In addition, the author has been working on moving the MIS classes from being teacher-centered to a more student- or learner-centered classroom environment. Moving to a student-centered course requires that the students assume responsibility for their learning. The teacher is there to help and facilitate the learning but no longer is up in front of the class lecturing, except where this is appropriate. This is not an easy transition, and it requires changing not only the teacher but also how the students think of the class. One way to do this is to help the students learn techniques or strategies that enable them to have a better understanding of the material and how to learn the material, beyond memorizing definitions and studying the night before the exam. In an article by Nancy Romance and Michael Vitale (1999), they suggested "concept mapping techniques as a strategy to include conceptual course content as a complement to student-centered activities (p. 74)."

Given the resources available in the computer lab, research was done to see what kinds of teaching strategies could be incorporated into the introductory MIS class. The author found the following approaches would be viable and could be done with the software currently available to the students. These approaches were concept maps (Visio©), concept matrices (MS Word©), flowcharting (Visio©), and adding notes to power point presentations (MS Power Point©). As tempting as it would be to have the students do flowcharts in this course, the author decided that it would not be as attractive as the other approaches. The following sections explain these approaches and how they were used in the course. The three approaches that were presented to the students are concept maps, concept matrices, and notes on power point and are briefly explained.

NOTE TAKING METHODOLOGIES
CONCEPT MAPS

When thinking about writing a paper or organizing material, one could begin by doing an outline. In spite of an outline, our brain may not work in the outline format. We think of a topic then leap frog to another topic that is related but does not directly follow the first topic. It can be very frustrating for us to try to organize our ideas to begin writing a paper that should have a logical format. In today's age of word processing this is easier, since we can jump from section to section. But it would still be nice to be able to conceptualize our ideas into a format that shows the relationships between the ideas without forcing any organization. The concept

map is one way of putting down our ideas and their relationships, which can then be moved to a logical outline for our paper.

What is a concept map? A concept map is a visual model of a topic. It will visually show through the use of nodes and links how the various categories or characteristics relate to each other without a formalized structure. This idea of drawing a visual model of a topic, concept or idea originates from G.A. Miller's work on the notion of chunking (Alpert, 2003), where working human memory handles seven active groups, and to access additional pieces of data or information our memory must expand on the active groups to obtain greater detail. It is this idea of chunking together key concepts and then exploding each of the key concepts into specific characteristics that gives the concept map its appeal.

Nancy Romance and Michael Vitale (1999) looked at the research on the application of concept mappings. One finding from the use of concept maps in the sciences included a consistent correlation between the quality of the concept map and other course assessments. They also noted the weakness of the time required to develop concept maps and that for some students this was not an attractive technique.

This idea has many different terms depending on the developer. In education the term is usually concept map, concept web (Freeman & Urbaczewski, 2001), or sometimes knowledge map. In business you often hear the term mind mapping stemming from Tony Buzan's work (Buzan & Buzan, 1996).

Concept maps can be drawn on paper or by using several software packages. Visio© does support the drawing of concept maps but it is not as easy as some of the other software packages. Other software that supports concept maps are Inspiration®, Webster®, and SemNet®.

For the first introduction to concept maps the author explained what concept maps were and how to draw them. The author felt that having the students learn Visio© before completing their first concept map would waste time, since the concept map would be lost as the students focused on learning Visio©. After the students completed their first concept map on paper, Visio© was taught and the students took the instructor's concept map into Visio©. The instructor's concept map was used so that the instructions given to the students would be applicable for all students. At the end of the class students were given five minutes to create their own concept maps in Visio©. This was not enough time and most students just left the lab.

The following steps were adapted from an article found on the Internet from the Grayson H. Walker Teaching Resource Center (2003).

Steps in Preparing Concept Maps

- Write down major terms or concepts about a topic
- Identify the most general, intermediate, and specific concepts
- Begin drawing the concept maps:
  - Concepts are circles (nodes)
  - Place the most general concepts at the top
  - Place intermediate concepts below general concepts
  - Put specific concepts on bottom
- Draw lines between related concepts
- Label the lines with words defining the relationship and arrows to show direction
- For each specific concept draw or identify an application
- Revise the map if necessary

CONCEPT MATRICES

Concept matrices, while similar to concept maps, use a grid structure. Maryellen Weimer (2002) defined the matrices as "a grid with defining characteristics across one axis and categories on the other (p. 174)." Jyostsna Kinnard (2003) in her article describes a "HyperDim Research Grid." This grid is a "non-linear, multi-dimensional tool that can be used as an electronic notepad for brainstorming, as a centralized repository of ideas for group projects; or as a medium to link concepts, lend perspective, and help students understand historical trends (p. 3)." The grid represents four quadrants. She used "features, impact, opportunities, and trends (p. 3)" in her IT courses. This grid is a tool to help students organize the concepts and how they are related. Other references to concept matrices were for mathematical, engineering or project management and didn't specifically relate to this use of a matrix. There was one software application called the Mind Matrix®, which is a Java application, but it was not available to the students in our computer lab.

The author decided to approach the development of a concept matrix in class using MS Word©. The other choice would have been MS Excel©. Initially the students in the introductory MIS course are more familiar with MS Word©, although they typically have not spent much time developing and working with tables. Since the author stresses applications, not just identification of terms, the following column headings were used: concepts, categories, characteristics, applications. An example of the concept matrix is shown in Appendix A.

The following steps were developed by the author for use in the MIS courses.

Steps in Preparing Concept Matrices

- Create a table in MS Word© that has 4 columns and 10 rows (the number of rows can be expanded later if necessary)
- Create the following column headings: Concepts, Categories, Characteristics, Applications
- Identify the main concepts of the chapter
- Identify the categories under each concept
- Specify the characteristics of each category
- Define an application for each of the characteristics
- Revise the matrix if necessary

NOTES ON MS POWER POINT®

The author had traditionally taught this course using a Power Point presentation covering the chapter concepts. Many students have printed out the power point presentation and take notes on the paper. Other students felt they could print the presentation out any time, so they were free to do other things in class. This created a very frustrating experience for some of the students and the instructor. To give the students an activity to do while the lecture was going on, the students were taught how to add notes to the Power Point presentation.

Steps in Adding Notes to a MS Power Point® Presentation

- Open the power point presentation
- Click so that the normal view is displayed
- Use the mouse to decrease the size of the power point slide, which increases the note taking section

- Place the cursor under the power point slide in the blank section
- Add notes to the power point presentation
- At the end of the session, save your file on your own disk.
- To print out the note pages select: File, Print, Print What, Note Pages, OK

THE EXPLORATORY STUDY

The author felt that the three teaching strategies explained above would be a viable approach to use in an MIS class scheduled in a computer lab. And that any of the three methodologies would engage the students during the lectures. It was not possible during the study to deviate from the lecture format since that was the expectation of the students and other faculty members. However the author decided to try an experiment with two sections of the introductory MIS course. The class would be taught how to do concept maps and concept matrices, and add notes to Power Point© presentations. Explaining the three approaches was time consuming and took the first two full weeks of classes to do this while covering and recovering chapter 1. Since the first chapter covered all of the concepts to be covered in more detail throughout the semester, the author did not feel that this was necessarily a bad thing.

As stated, the semester began by the author explaining to the students the various teaching approaches in general and the format for the exploratory study. If the students wanted to participate in the study, they could take the test at the beginning of the semester (pre-test) and again at the end of the semester (post-test). As an incentive if the students took the pre-test they would earn five bonus points. Five bonus points were also given at the end of the semester for taking the post-test. The course grading schema used 800 points so the 10 bonus points would not adversely inflate the grades for the course.

The first approach taught was taking notes using Power Point©. This was done first since it would be the most familiar approach for the students, thereby getting them comfortable using the computers in the lab. The second approach presented was the concept matrix. Again, chapter 1 was covered. The students were given the basic template with the concepts, categories and characteristics completed by the instructor. The student then added the applications for each characteristic. These were in the student's words to give the concepts personal meaning. The third approach taught was the concept map. Since Visio was not a software tool that most of the students were familiar with, the first concept map was done on paper; using colored pencils was optional. The students were then shown how to take their paper maps and put them into Visio. This was very slow and the students were frustrated many times. On hindsight, the use of Visio© should have be postponed until the decision was made on what teaching strategy was to be used in each section.

The next action required the students to participate by voting, electronically, on which approach the class should take for the remainder of the semester. The instructor, when asked if they could change later in the semester, agreed that if the class wanted a revote, that could be done at any time it was requested by at least 3 students in the class. After the votes were completed each section decided to use a different approach. The results of the votes are presented in Table 1. Section 6 clearly chose the concept matrices approach and section 7 clearly chose adding notes to Power Point.

The instructor did lecture differently for each section. For section 7, Power Point slides were used and to keep the instructor on topic. For section 6, initially a concept matrix was used with the concepts, categories, and characteristics given the students. Then after the first exam or the completion of one fourth of the course material, the students were given the concepts and categories. After the second exam, the students were given the concepts only. After the third exam, the students had to fill in all of the columns. The instructor would lecture using slides from the textbook to illustrate key points and to provide some direction for the lecture. Initially students asked what would be examples of applications, but about one third of the way into the semester, the class would throw out suggestions for applications. This was very helpful, since it got the students talking and paying attention in class. Also they enjoyed being the ones who suggested applications that everyone else thought was good enough to put in their matrices.

Table 1
Student Voting Results for
Teaching Approach to Be Used

Section	Class Size (N)	Notes	Maps	Matrices	Didn't Vote
6	36	4	2	27	3
7	34	23	4	3	4

Neither the Power Point© notes nor the concept matrices were collected by the instructor. A couple of times during the semester the instructor would ask to see examples of their work but it was not for grading, just a reminder to keep them on task during class. In looking at the student evaluations of the course during the following summer, there were several comments that the notes or the matrices should have been collected for points since they were a lot of work. It would have been nice to be able to compare the students who had this comment to their final grade. Anecdotally, the students who did very well in the course, commented that it was worthwhile to do either approach so they had their notes to study for the exams.

Towards the end of the semester the instructor was reading about teaching approaches and that no one approach works for every students. Many researchers are tying teaching approaches to student learning styles (Sutliff & Baldwin, 2001; Wilson & Cole, 1996, BizEd, 2003). Students were asked to go to two web sites and determine their learning styles using the Myers Briggs scale (www.typefocus.com) and the DVC four learning styles (www.metamath.com/lsweb/fourls.htm). The Myers Briggs scale brought back four dimensions; this study used the introvert or extrovert classification, the first of the four dimensions. The other Myers Briggs dimensions are sensing or intuition , thinking or feeling, judgment or perception. The four Myers Briggs dimensions could not be used due to cell size problems. The DVC four learning styles looked at visual, auditory, kinesthetic and tactile dimensions.

The concept comprehension pre- and post-tests given at the beginning and end of the semester were identical. The test was made up of 30 multiple choice questions from the instructor's test bank. The test covered all the material to be covered during the semester. Students were assured that at the beginning of the semester they were not expected to know the answers.

RESULTS

The study looked at many different data items for analysis: the pre-test score of correct answers, post-test score of correct answers, difference score between the pre- and post- test, the student's age, gender, the student's learning style – introvert or extrovert, and visual, auditory, kinesthetic, tactile or balanced. In addition the students' grades on exams and course assignments were input to see if there was a correlation between the teaching approach and individual grades on assignments and exams. The classes began with 36 students in section 6 (matrix) and 34 students in section 7 (ppt). Twenty-one students from section 6 (matrix) completed the pre- and post-tests, while only sixteen students from section 7 (ppt) completed the pre- and post-tests. These were the only participants used in the statistical analysis. Twenty-four of the participants were female and thirteen were male. The student ages ranged from 19 to 43. Thirty of the participants were under 28 years old. Ten students were 23 years old.

Using cross tabs and chi-square analysis there was no difference between the sections by gender, age, pre-test, post-test or grade. In addition there was no difference between the sections by learning style for either the DVC four learning styles scale or the Myers Briggs scale for introvert or extrovert. And there was no difference between the DVC four learning styles scale and the Myers Briggs by gender. Additionally, there was no significant differences between the sections for the grading components or the total points earned. Therefore, we can conclude that the sections were homogeneous.

There was a marginally significant difference in the post-test score by gender. Female students did better than male students (16.7 vs. 14.3). The women's score had a significant improvement between the pre-test and post-test (14.25 to 16.7) whereas the men's score dropped but it was not significant. The women in section 6's (matrix) score improved from 14.4 to 16.5 and the women in section 7's (ppt) score improved from 14 to 17. The score for the pre-test, post-test, and difference is the number answered correctly. For example, 14.4 means that the average was 14.4 questions answered correctly. The men in section 7 (ppt) improved from 15.1 to 16.7. Introverted students tended to have higher pretest scores in section 6 (matrix) than the extroverts ($p = .10$). Introverts earned more points on the pre-test and for the difference score ($p = .10$). In section 6 (matrix) kinesthetic and tactile had marginally higher post-test scores. Auditory, visual, and those students that were balanced between the four dimensions scored marginally lower on the post-test.

LIMITATIONS OF THE STUDY

There are several limitations of this exploratory study. The first one is that student grades were not affected by the teaching approach. This could be good from the students' and instructor's perspective, since this would suggest that instructors can try different teaching approaches and not adversely affect the student's final grade. The exploratory study was designed to not be reflected in the students' grades; however, having the post-test be a factor in grade determination may have eliminated guessing or not really trying to answer the questions correctly. On the other side the author felt that this just suggested that course assessments may not truly assess the level of concept mastery by the students. Or verify that they know the material well enough to build on it in future courses and/or after graduation.

The other limitation of the study is the number of participants and the lack of a section using the concept maps. The author has been doing the same approach for several semesters but has not had the luxury of having two sections of the introductory MIS course since the Spring 2003 semester. The students have been allowed to do any of the approaches; however, Visio© has not been taught. In addition, the first chapter has not been repeated three times as during the experimental semester. The instructor covers creating concept maps and matrices, and how to add notes to the power point lectures using different chapters. One student who received the highest grade in class sent the instructor an email that stated, "I really like the concept matrices and I did them for each section in the course. The matrices really helped me understand how the material was related and putting the applications in my own words helped me remember what the characteristics meant for the exams." I thanked her for her comment and asked if she would recommend them to other students. Her reply was "YES."

Other student comments sent to the instructor from the study group via email acknowledged that trying new teaching approaches was appreciated by some of the students. For example, ED stated "I'm thankful that a teacher would care enough to try something new in the classroom." JD sent "I didn't like the mind maps but I was talking about them to my boss. She has a son with learning problems and she thought this might help him. She asked if you had any references, so she can learn more about mind mapping." And JB commented "I liked the mind maps but maybe it was just the colored pencils. Anyway I wanted to let you know I will be doing these on my own. Can I borrow some of your colored pencils?"

CONCLUSIONS

This is an exploratory study, which the author undertook for two reasons: to evaluate different teaching approaches and to re-energize the instructor. From the instructor's perspective this really did require a new methodology to teaching, openness to student decision making and control over the course, and to really look at the introductory management information systems course material. The instructor's bad habits showed up and some were caught by the students in the section using the concept matrices. This study did not overwhelming convince the author or other colleagues that changing our teaching approach will improve the students' learning of the material. Then again, it showed that what we do in the classroom may not positively affect the students but it didn't negatively affect them either. About the same number of students from the two introductory sections went on to the next course in the MIS sequence, Database Management, as usually do.

The feedback from students indicated that they were pleased to try something new. No negative comments were sent to the instructor either through email or through the student evaluations. In asking other colleagues, they did not hear negative comments about the experiment. Would the author recommend other instructors try this: YES without reservation. But be aware it is more time consuming and risky for the instructor. However, this teacher has been re-energized about teaching and no longer feels that the classes have to be the same: that both the instructor and students can be taught new teaching approaches.

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APPENDIX A
AN EXAMPLE OF A PARTIAL CONCEPT MATRIX