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An Investigation into the Assessment of Students' Understanding of IS

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Abstract

At the end of a four-year undergraduate program, it is often difficult to capture the knowledge of the graduating students. The use of mental models, specifically concept maps, can aid in the assessment of this knowledge at a conceptual level. Concept maps provide a visual representation of conceptual and relationship knowledge within a particular domain. Students in a senior-level, undergraduate class were given an assignment of creating conceptual maps of Information Systems. These maps were coded and analyzed for their "coverage" or conceptualization of the sub-field of Telecommunications. The analysis included both quantitative and qualitative assessments as well as comparisons across students' maps. Preliminary assessments have indicated that there is a fairly large degree of overlap between maps, though a full analysis is not yet complete.

Introduction

As IS educators, we are tasked with preparing students with a broad education in business and computer information systems, but measuring their total knowledge can be difficult. While the students are often tested in each of their classes on the topics and concepts for that particular class, there is rarely a unifying measure of their knowledge gained over the entire period of time. Of course, faculty could give these graduating students an all-inclusive "test" to see what the students do remember from their previous courses, but this seems impractical and highly susceptible to measurement errors producing unreliable data.

An alternative approach to knowledge assessment is the use of mental models, and specifically concept maps or concept webs. By creating a visual representation of a student's cognitive conceptualization of the field of information systems, viewers get an inside look into that student's mind. The concepts and their relationships to each other are represented visually, showing the items that the student knows, their relationships, and the items that the student does not feel are important enough to be included.

Concept maps are typically assessed by comparing them to an expert's map in either quantitative or qualitative forms. Other assessment techniques include counting the number of concepts and the number of relationships to determine the degree of complexity.

The purpose of this research is to illustrate the potential uses of concept maps as an assessment tool of students' conceptual knowledge of a domain - information systems. These concept maps could potentially be used as an overall assessment of the department's teaching efficacy or, more simply, as a view into the minds of the students.

Prior Literature

The use of mental models, specifically concept maps, can aide in the assessment of knowledge at a conceptual level (Fisher, 1990; Fisher et al., 1990; Gaines & Shaw, 1995; O'Neil & Klein, 1997). Concept maps provide a visual representation of conceptual and relationship knowledge of main concepts and major sub-topics within a particular domain (Hoover & Rabideau, 1995). Concept maps consist of nodes that represent the concepts and arcs that connect the nodes and represent the presence of a relationship. Concept maps look like a spider's web consisting of many concepts or nodes connected to each other by lines signifying the presence of relationships.

Other forms of mental models such as cognitive maps, semantic networks, and schemata can also be used to represent relationships between concepts. However, they differ from concept maps in that they also include directionality to the relationship or causality between the concepts (Fisher, 1990). Concept maps were chosen as the assessment method because they do not require any temporal or cause/effect relationships between the concepts.

Concept maps have been used for many years as a means for communicating knowledge in fields such as education, biology, history, mathematics, engineering, computer science, and communications (e.g., Cliburn, 1986; Gaines & Shaw, 1995; Wallace & Mintzes, 1990; Williams, 1995). This study continues the use of concept maps by applying them to the field of Information Systems and IS conceptual knowledge.

Methodology

Thirty-nine students in the senior-level, capstone undergraduate course in IS at a large, public, Midwestern

university were given an assignment of creating concept maps of their conceptual understanding of the field of Information Systems. They were required to create their concept map in a graphical format, but were not restricted as to the method, the tool, or the physical display size of their map. As part of the assignment, their maps had to include at least 150 distinct concepts or items and the appropriate relationships between concepts (according to their own understanding and view).

A short training exercise was provided during the third class session of the course. The assignment was due on the last day of classes, allowing students 5 weeks to complete the assignment using whatever resources and material they felt necessary, except for each other. The assignment counted for 10% of the total points for the course. The first author was the instructor for this class and answered all questions from the students regarding the assignment.

Analysis

For reasons of brevity and focus, it was determined that only a subset of the students' concept maps, that which relates to Telecommunications, would be analyzed for this paper. For the purposes of this research, Telecommunications (Telecom) includes topics such as the Internet, networking, cabling, and communications, among others. Our choice of Telecom represents our belief that (1) this is an issue that is of importance to the students given society's focus on the topic, (2) the students' understanding and conceptualization of Telecom is neither "old" nor "new" since the Telecom course is taken part way through the typical IS curriculum at this institution, and (3) the potential conceptualization of Telecom by the students will contain enough distinct concepts for analysis without comprising the entire map.

Of the 39 concept maps received, any map that was judged to be in discordance with the instructions and therefore not usable for this study was eliminated from the sample group.

The remaining concept maps were then analyzed in the following manner: Each map was redrawn verbatim, but only focusing on and including the concepts and relationships regarding Telecom. The cutoff for inclusion was to not include any concept and the associated relationships if that concept would not be included in a typical textbook chapter on Telecom or Internetworking. Therefore, "e-mail client" would be included, but its relationship to "software" and "software" as a concept

Conclusion

Due to not having a complete analysis at this point, no specific conclusions can be made. However, there are several other issues, which can be discussed, that do not rely on the actual maps.

would be beyond the scope of Telecom. Both authors independently redrew each map and then compared the redraws for consistency and for concept categorization.

Following these redraws, the maps were randomly split into two groups. Using the maps from Group A, a set of consistent terms was developed to create a consistent coding scheme for all of the maps. This coding scheme was then applied to Group B, and the maps from Group B were redrawn using the new coding scheme. Any concepts that were part of Group B, but not included in the coding scheme, were added to create a more robust scheme. The maps from Group A were then redrawn using this revised coding scheme. This process was repeated until all concepts from Groups A and B were accounted for in the coding scheme and all of the maps had been redrawn using the finalized coding scheme.

At this point, comparisons were made to assess the overlap of the individual maps with each other. The students' concept maps were also compared to the concept map of an "expert" - a faculty member who teaches Telecom at the same institution. Additional analyses were made regarding the number of concepts per map, the total number of relationships, and other quantitative measures. Qualitative assessments were made regarding the knowledge and conceptual understanding of Telecommunications that were displayed in the maps.

Results and Discussion

The above analysis is still in progress. Without the completed analysis, a discussion of the results and what they imply about the students, the curriculum, and the task is not possible. The analysis will be complete by the conference date when all data and results will be discussed in full.

The analyses will provide insight into several issues. First, we will gain an understanding of what the students know (or at least feel to be important) regarding Information Systems, and specifically Telecom. Second, comparisons of the students' maps to the expert's map will provide us with information regarding how much is remembered from the Telecom course and whether the concepts that are remembered and included are done so "correctly" according to the expert. Finally, if there are major differences between the student maps and the expert map, changes may be necessitated in the teaching of the Telecom class(es) so that the students have closer conceptualizations to the expert.

First, it should be noted that the students found the assignment to be fun. When the assignment was first described early in the semester, students were very hesitant with regards to their approval. However, as the course moved along and as the deadline approached, the first author

was approached with questions, signifying that the students were actually working on the assignment. In the end, when it was turned in, many students commented that they learned a lot from the assignment and that they found the assignment to be enjoyable, especially since it was so different than any other assignment they were doing at the time. These comments match those found by Taber (1994).

Second, the assignment was completely an individual assignment. The creation of concept maps in group settings is a separate issue, though this would have been an interesting exercise and may therefore be appropriate for future studies. Similarly, there were no comparisons within individuals over time. Research suggests that concept maps indeed show the differences between novices and experts within a field (e.g., Markham et al., 1994; Wallace & Mintzes, 1990), so future studies should analyze the differences in concept maps from individuals drawn at different points in time.

Third, there are several potential weaknesses with this study. While the assignment was an individual assignment, at the same time, there was no control over the students (such as in a laboratory setting) to assure the researchers that there was no outside collaboration by the students. This could therefore be seen as a potential weakness of this study, though the students were bound by the Student Honor Code. A second weakness is that the assignment covered a 5-week period. It was not a snapshot in time. Concepts maps drawn over 5-weeks will likely be different from concept maps drawn within a time period of several hours, though it could be postulated that many students waited to complete the assignment until near the due date.

Finally, this was an initial study of the assessment of students' knowledge using concept maps. The above weaknesses and limitations can be controlled for and possibly reduced through additional studies. In addition, the entire concept map needs to be analyzed, or at least additional sub-fields. Potential applications of concept mapping as a tool for knowledge assessment exist both in academia and in industry. This study is one small step towards a better understanding of the use of concept maps and their usefulness as assessment tools.

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