

INSTRUCTIONAL DESIGN AND ASSESSMENT

Concept Mapping in a Pharmacy Communications Course to Encourage Meaningful Student Learning

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Objective. To create a concept mapping assignment that emphasizes meaningful learning and discourages rote memorization of course material, thereby improving student retention of pharmacy communications information.

Design. Students in small groups created concept maps that demonstrated their understanding of major concepts taught in the course and their interrelationships.

Assessment. Student assessment focused on the meaning that students derived from the material taught to them. Grading for 2 student concept maps was compared. Student perceptions of the assignment were sought and reported here.

Conclusion. Incorporating a concept map assignment into an existing course requires a significant investment from instructors. The reward for faculty members is that students learn to understand abstract material and grapple with conceptual meanings so that they are challenged to move beyond rote memorization to meaningful learning.

Keywords: concept mapping, learning, student assessment, communications

INTRODUCTION

Encouraging students to achieve long-term integration of knowledge is a challenge to all faculty members teaching in higher education. Many students have learned to rely on rote memorization in their early college years to obtain the “right” answers. This method may be successful for completing prerequisite courses, but in a healthcare profession such as pharmacy, knowledge must be retained for application in complex practice settings. Professionals must therefore achieve a sophisticated understanding of the conceptual tools within their discipline. Novak commented that students can be tenacious in their preference for rote memorization because of previous success with the method and because memorization requires a smaller investment of mental energy than learning to fully understand course material.¹ Over-reliance on rote memorization is counter-productive to retention of meaningful knowledge, and knowledge gained this way requires intense effort and frequent reinforcement to maintain.²⁻⁵

Concept mapping was selected as an active learning process that involves students in meaningful learning because the process engages complex cognitive structures within the brain. The learning tends to be long last-

ing because the new knowledge is related to and integrated within a person’s existing knowledge structure.³ Cognitive learning theory indicates that the brain learns most effectively by relating new experiences and knowledge to prior knowledge, and that meaningful learning requires deliberate effort to link new knowledge with higher-order, more inclusive concepts in a person’s cognitive structure.^{2,6,7}

Instructors are able to influence student choices of how to learn with their decisions regarding how material is presented in class, the creation of exercises that engage students with course material, and how student learning is assessed.⁵ As a graphic knowledge representation tool, a concept map enables students to diagram their understanding of key ideas in a topic area and to demonstrate their conceptions of the relationships among them.^{3,8} Students are often able to articulate key concepts within course material, but they may be unclear about the relationships among them and their relative importance.² A concept map assignment can help students listen for meaning in class, assist students in taking more effective notes, and promote conceptual learning.

The use of concept maps has spread since it was first described in the 1960s and later documented by Joseph Novak and Bob Gowin.⁸ An article in the *Teaching Professor Newsletter*⁹ indicates that concept maps are being used for educating students in different disciplines including sociology,² physics,⁷ chemistry,¹⁰ organiza-

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tional development and adult education,¹¹⁻¹³ psychology,¹⁴ and dietetics.¹⁵ They are being used for varied educational purposes including teaching and providing students with advance organizers; improving comprehension and retention; encouraging cooperative and collaborative learning; developing databases that support problem-based learning, curriculum development, and fostering problem-solving; critical thinking; and transformative learning.⁹ Some faculty have used concept mapping for research regarding teaching and learning.^{5,11} Educators in the health professions have adopted the use of concept mapping, for example, in nursing¹⁶⁻²¹ and medicine.²²⁻²⁵ In pharmacy education, concept maps are being used for purposes such as improving comprehension in therapeutics,²⁶ teaching pathophysiology,²⁷ improving students' problem-solving ability,²⁸ and designing computer and web-based instruction.²⁹⁻³²

Concept mapping has been used for assessment of student learning in many fields.^{2,10,14,23-24,33,34} For example, repeated concept mapping over the course of a semester was found to promote both conceptual and critical thinking in nursing education.¹⁷ In comparison, multiple-choice tests can only measure a small sample of student learning within a course, and tend to emphasize students' ability to memorize. When students have received instruction in concept mapping and have sufficient time to practice, their concept maps can display the greater depth of student learning because the method reveals how they (1) organize their knowledge, (2) understand the relationship of various concepts and propositions, and (3) display the creativity they used to integrate additional concepts. It is relatively easy for a knowledgeable faculty member and/or practitioner to evaluate the significance of the concepts students select, the sense of the map's organization, and any errors in their conceptualization of information.² Roth and Roychoudhury suggest that concept mapping can serve to facilitate collaborative and cooperative learning.⁷

For most students, learning to create a concept map is an unfamiliar process. Some students will have experience with mind mapping and other brainstorming techniques and must be taught to differentiate what is unique to a concept map, namely the creation of linking words to indicate relationships between concepts, development of a clear hierarchy to differentiate general concepts from specific ones, and the use of cross-links to demonstrate logical connections between different sections of the map. Because of its unfamiliarity, expectations for students must be clear and specific and a credible rationale for why they are required to undertake this assignment must be provided.

Conceptual mapping has clearly demonstrated its utility in helping students learn in the natural sciences. Trepagnier argues, however, that requiring students to create concept maps is especially useful in teaching abstract, conceptual topics in which there may be multiple ways to interpret the interesting and abstract relationships between concepts.² In an interdisciplinary study of intellectual development of postgraduate students, Donald found that the sciences tend to teach more concepts within a single course than the social sciences, but that the meanings of these concepts tend to be explicit and specific. In the social sciences, as much as 90% of subject matter may be abstract.⁵

DESIGN

The Assignment

Learning about pharmacy communications requires students to engage with abstract notions of the social, psychological, and behavioral aspects of pharmacy care. The *Communications in Pharmacy Practice* course at the Virginia Commonwealth University (VCU) School of Pharmacy is a 2-credit core course that is currently offered in the first semester of the doctor of pharmacy program. The content (1) addresses communication skills employed in pharmacy practice with an emphasis on patient counseling and education, (2) explores communicating with diverse populations including geriatric patients, mentally ill patients, and patients with disabilities, and (3) provides instruction about low health literacy and cultural competence. Students are introduced to pharmacy practitioners working in a variety of practice settings, and practice their developing skills in small conference groups with a group leader who is a faculty member currently engaged in clinical practice. One hundred nine students were enrolled in the course in fall 2002.

The concept mapping assignment was added to the course because the existing course structure did not appear to encourage students to engage with the material and students were not retaining information they need to successfully engage in the advanced pharmacy practice experiential program and in practice after graduation. An introductory class session is devoted to explaining the process of concept mapping and the purposes of the assignment. A detailed presentation explains the structure of concept maps and their relevance to education and then provides opportunities for questions. Students are engaged in an exercise in which they practice creating a simple concept map of their existing knowledge of pharmacy communications at the outset of the course. Students also receive handouts that (1) explain the assignment; (2) include a concept map that

demonstrates the general structure; (3) provide an example of a relevant concept map; and (4) specify scoring criteria used for grading (Appendix 1). Students are also shown the final products of students who completed the course in the previous year, although they may not retain these.

Students are required to include 3 concepts: (1) the pharmacist, (2) the patient, and (3) pharmacy care. They are encouraged to incorporate material from other courses, but must demonstrate the connection of this material to pharmacy communications. Students submit first and second drafts during the semester, and a final draft is due on the last day of class. Each draft is graded, but the grade value of the first and second drafts is kept low so that the experience involves minimal risk as students develop greater skill in working with concept maps. The final draft of the concept map is weighted so that together the 3 drafts of the assignment represent 25% of the final grade. The students are also graded on their participation in small group conference activities, and complete 2 midterm and 1 final examination.

Students worked in self-selected groups of 3 to 5 to create a mutually acceptable concept map and a narrative that explains the decisions made in its organization. The map that individual students created of their existing knowledge of the role that communications skills play in pharmacy practice provides them with the material with which to begin their group conversations and helps students document their existing knowledge for the narrative. In order to create a mutually acceptable group product, students cooperate and negotiate meaning within their group discussions.

When asked to work in small groups to produce a graded assignment, students are understandably concerned that each group member contributes equally and that the work will be of good quality. This can be difficult for an instructor to monitor in large classes, so students are asked to submit self-assessment and peer-evaluation forms each time their group submits a draft. Students seem unwilling to rate each other poorly on the peer evaluation forms. In contrast, the self-assessment form asks students to log their individual efforts that contributed to creation of the group's concept map by describing and dating the activity and recording how much time they invest. The instructor can monitor how many hours each group member contributed to the project, and when large discrepancies occur, decide whether instructor intervention is appropriate.

Concept maps can be produced by hand or by using the drawing tools available in word processing software. Both methods of making changes to the map become

more tedious and time-consuming as students' concept maps increase in complexity. Graphic visualization software can facilitate the creation and revision of concept maps because it permits rapid manipulation and reorganization of items. Further advantages of computer support for concept mapping include conversion of concept maps to other file formats, electronic communication of finished products, and digital storage and retention.³⁵ One example is *Inspiration* (Version 7, Inspiration Software, Inc, 2002), an inexpensive software program that supports graphical ways of working with and presenting ideas. Use of the software also helps to alleviate the possibility of students perceiving concept mapping as "busywork."

ASSESSMENT

Scoring criteria for each portion of the assignment allows assessment of student learning (Appendix 1). Novak and Gowin propose that several elements can be graded in the concept maps including the meaningfulness and validity of the (1) concepts selected, (2) choice of linking words that explain the relationship between 2 concepts, (3) hierarchical ordering of concepts within the map, (4) cross-links established between sections of the map, and (5) examples that illustrate the map's concepts.⁸ Grading criteria for the narrative are based on a groups' explanation of the decisions made in constructing the map, ie, how their narrative relates to their concept map, how the map is structured, and how they chose to integrate key concepts of the course. The narrative is also graded on students' explanations of how their knowledge changed during the semester.

One student concept map is reproduced here with the students' permission (Figure 1). Table 1 compares the grades for 2 student groups. Grades for the narrative are not included. Both groups produced good concept maps; however, that of group B (not shown) had more depth. Both groups used an equal number of concepts. Group A lost points by not explaining the relationships between concepts as often as Group B, meaning that some of their links between concepts were not described by linking words. However, Group B used more examples. Group A's map had 6 levels of hierarchy, while Group B's used only 5. Group A included 6 viable cross-links, and Group B detailed 6. Both groups used creativity in their arrangement of the map. The emphasis given to positive patient health outcomes in Group A's map is noteworthy, while the inclusion of the principles of the Oath of a Pharmacist in Group B's map is interesting. Faculty colleagues who viewed the students' concept maps were very intrigued with them, and one suggested that several were of publishable quality.

For all student groups, the number of concepts, linking words, cross-links, and examples increased with each succeeding draft they produced as the course progressed. The hierarchy of concepts also increased over time, but tended to stabilize after the second draft. The relationship between concepts and the cross-links between sections of the map contributed most to the final score because the number of each tended to increase as the concept map became more complex. The emphasis in grading both the concept maps and the narrative should be on the meaning

Table 1. Comparison of Grading for Student Groups

Criteria	Grade	
	Student Group A	Student Group B
Concepts selected	47	43
Relationship between concepts	11	44
Hierarchy	25	30
Cross-links	40	60
Examples	8	12
Total	131	189

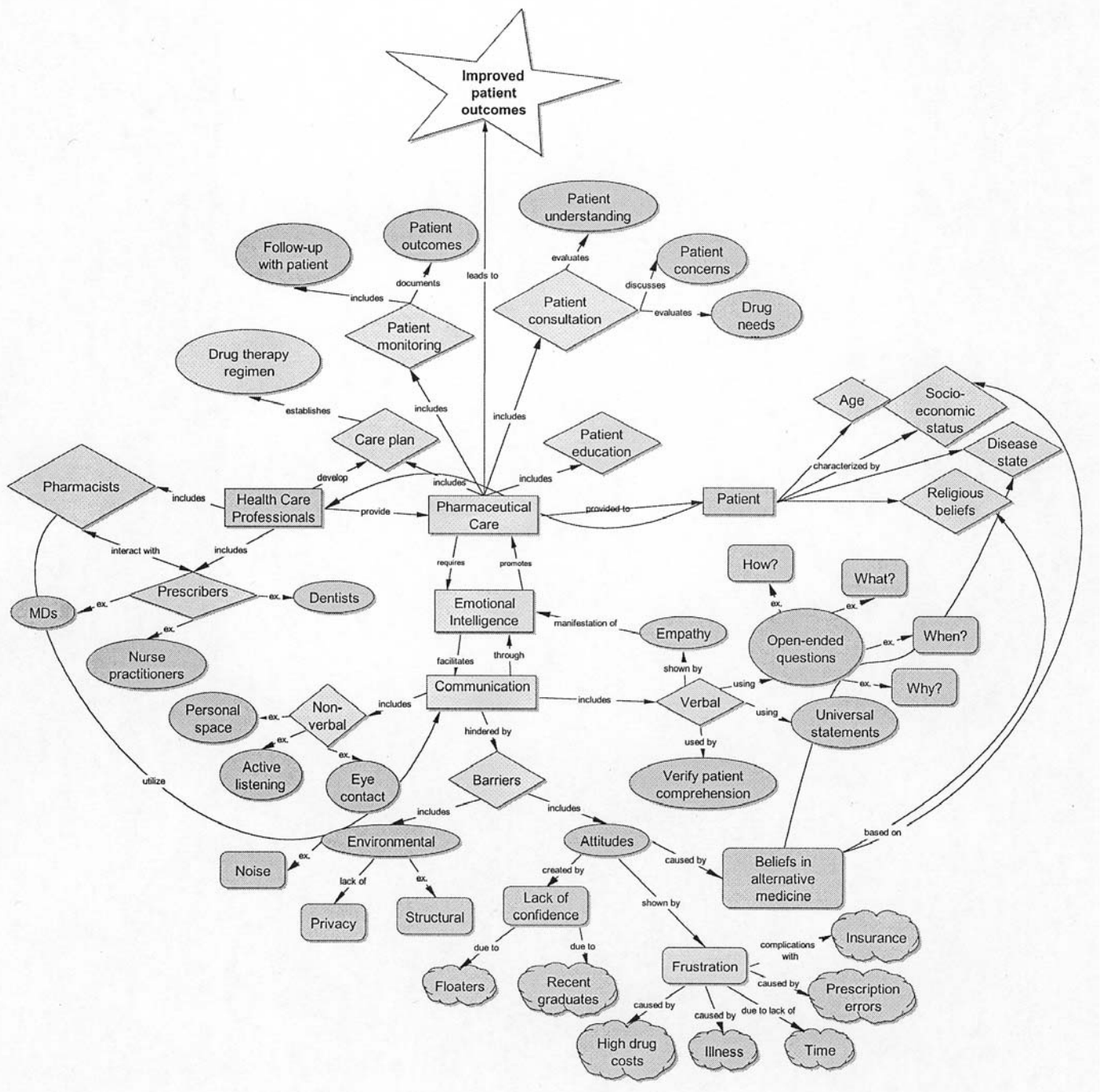


Figure 1. Final concept map of student group B.

that group members have made from the subject material in the course and its interrelationships, to avoid simple counting of the number of elements included. If students suspect that numerical scoring prevails, they may be tempted to crowd their maps with as many concepts and linking words as possible, and to create multiple cross-links whether or not they have validity. A similar evaluation rubric developed by Trepagnier² recommends examining the original thinking used in developing links between concepts and their accuracy, the theoretical accuracy demonstrated by directional arrows within the maps, and the accuracy and creativity displayed in writing the narrative. Maps that were rated as excellent had accurate and insightful links on the concept maps and indicated independent thinking. By contrast, maps that needed improvement or were unsatisfactory included inaccurate links and misconceptions in both the map and narrative.

Students' Perceptions of the Assignment

Information regarding students' perceptions of the class and the assignment was collected during the semester. Students were asked to complete an informal formative evaluation form containing sentence stems including: "I learned the most when...", "I had the most difficulty with...", "I was surprised by...", "Things became more clear to me because...", "I will remember this material because...", and "The concept map..." Students were able to make comments in each category. Students' comments and their frequency are reported in Table 2.

Approximately half of the students appeared to have enjoyed the assignment and they commented that they found it useful in organizing their ideas, retaining information, and relating the communications course material to other courses in the curriculum. Nearly as many students responded that the concept maps were challenging and provided them with some difficulty, yet at the same time they found concept mapping a useful exercise that helped them better understand the role of communications and the pharmacist in providing pharmacy care. Two students commented that they appreciated gaining experience with a new learning tool that they could use to study for other courses. One stated that it was her favorite part of the course.

The students' comments were similar to those documented by Trepagnier,² who reported receiving a mixture of positive and negative comments from students. Student responses indicated they experienced both disequilibrium and equilibrium during the concept mapping process. Disequilibrium signifies that students experience uncertainty and search for information to clarify their understanding, while equilibrium refers to regain-

ing comfort with material by achieving understanding and the restructuring of mental schema held about the subject. Trepagnier reported that most students felt the exercise helped them learn the concepts taught in the course. Novak concluded that the sophisticated concept maps produced by university students represent an enormous amount of knowledge. The construction of the map requires considerable creativity in organizing the structure of the map; selecting important, relevant concepts to add to the map; and searching out salient cross-links, which indicate relationships between concepts in different sections of the map. Needless to say, the map becomes an important learning experience as well as a unique evaluation experience.^{1(p192)} Novak noted that students need practice and constructive feedback on their efforts to create concept maps.

DISCUSSION

The quality of most of the concept maps was excellent, and it was immediately obvious which groups had invested significant time, effort, and creativity in creating their maps. One student liked the technique so well she used the method to study for anatomy examinations. Conversely, a few students indicated they did not believe they were visual learners and that the assignment did not suit their learning style. In a class of more than 100 students, different learning styles will always be present. While many styles can be accommodated within a course, people must also learn to learn in different ways regardless of whether they are immediately comfortable. Some students may be initially uncomfortable with the concept map assignment because of unfamiliarity with it and the experience of mental disequilibrium this assignment and all learning have the potential to create. Novak commented that while students may recognize the value of concept maps as learning and evaluation tools, they also recognize that creating a worthwhile map takes significant time and effort.³ After years of schooling that emphasizes rote memorization of information, instructors should not be surprised that students resist being asked to take responsibility for constructing their own meaning. If assessment measures require rote, verbatim recall of information, students are neither encouraged nor rewarded for making the effort to learn meaningfully.¹

Incorporating a concept map assignment into an existing course requires the instructor to invest significant thought, time, and effort. It is necessary to review the course learning objectives and think about how the assignment will help students achieve them. Instructors need to develop clear expectations for students and explanations for the assignment, as well as a credible

Table 2. Frequency of Student Responses to Formative Evaluation Questions Regarding a Concept-Mapping Assignment (n)*†

<p>The Concept Map . . .</p> <ul style="list-style-type: none"> • Was a helpful tool in exploring communications and pharmaceutical care and in understanding the role of the pharmacist in patient care.(8) • Is challenging.(8) • Is a good experience. I enjoy coming up with new concepts and figuring how it relates to others.(7) • Is a new assignment for me. It really makes you sit down and put everything together.(6) • It organized my ideas from reading and lectures.(5) • Helped me learn and remember better the concepts presented in class.(5) • Is a fun way to link our ideas and show what we know and what we learned.(4) • Helps to clarify knowledge about the practice and the profession of pharmacy.(4) • Is a good and applicable concept that can be applied to other classes used as a study aid.(4) • Was a good, innovative way to learn about communications.(3) • Does not help me understand the relationships we discuss.(3) • Finding time to work on it is the hardest part.(2) • Was somewhat difficult for me to understand and create.(2) • Helped me to see the broad idea. Is a good way to organize ideas.(2) • Takes a lot of time and coordination.(2) • Is helpful in connecting ideas that we related to pharmacy and remembering them.(2) • Is a great opportunity to work in groups and learn pharmacy practices from my peers.(2) • Helps to put info from different classes together.(2) • Made me think more about what I'm getting into.(2) • Seemed like an easy idea at first, but was harder when it actually came time to do it.(2) • Is confusing, but it helps to learn more about the different aspects of health care.(2) • Was a valuable learning tool and more difficult than I had anticipated.(1) • Importance/value remains to be seen.(1) • Proved to be an interesting way to explain something and to teach and learn other concepts.(1) • Was my favorite section of the course!(1) 	<p>I was surprised by . . .</p> <ul style="list-style-type: none"> • How helpful concept mapping is as a learning tool.(1) • How easy it was to use the concept mapping software.(1) • My ability to come up with concepts for the map.(1) • How easy it is to become carried away with the concept map, i.e. I had too many vague ideas.(1) <p>I will remember this material because . . .</p> <ul style="list-style-type: none"> • I used the concept map to give the information structure and how it fits into the scheme of things.(1) • The concept map has helped me to relate to the concepts better in class and conference has helped to reinforce it.(1) • I related it to concept mapping and was able to organize the material.(1) <p>I had the most difficulty with . . .</p> <ul style="list-style-type: none"> • The concept map.(10) • Knowing how to organize the concept map with linking words.(8) • Getting started on the concept map, but once we organized our ideas it became easier.(6) • Finding linking words for the concept map.(3) • Writing the narrative for the concept map.(2) • Formulating ideas for the concept map.(1) • Simplifying and linking concepts together in map. It felt more like brainstorming than orderly progression.(1) • Learning how to construct our concept map in an organized manner.(1) • Breaking down the concept map topics.(1) • Getting ideas for the concept map.(1) • I am not a visual or artistically-oriented person, so this is very difficult.(1) <p>Things became clear to me because . . .</p> <ul style="list-style-type: none"> • I looked to my concept map for organization.(2) • I used a concept map as a tool to learn important information.(1) • By using concept map skills, I could organize things better.(1) • I studied from the concept map.(1)
<p>I learned the most when . . .</p> <ul style="list-style-type: none"> • I was researching the concept map.(1) • Using the concept mapping.(1) • We connected all the lines in the concept map and made the final product.(1) • Putting all the thoughts together in the narrative for concept map.(1) 	

*Students could write multiple comments in each category, but the majority provided only one response.

†The number in parentheses after each response indicates the number of students who gave that response.

rationale for why they will be required to engage in this unfamiliar process. Grading concept maps also requires a large time investment, particularly when several grading points are spaced across the semester. The rewards are that concept mapping can help students understand abstract material within a course, integrate learning from related courses, and engage students in grappling with conceptual material so that they are challenged to move beyond rote memorization to meaningful learning. Instructors can dialog with students about course topics in a novel way and gain appreciation for the depth of student learning. Students benefit by gaining experience with a new learning tool, and because of the way this assignment is structured, students also gain experience with teamwork and collaboration as they work to create a mutually acceptable final product.

CONCLUSIONS

Using concept mapping in the pharmacy communications course was a learning experience for the students and instructor alike. Using mapping concepts in a course that addresses abstract material and pharmacist-patient interactions the students will have in the future supported students in their efforts to integrate what they were learning into their existing knowledge, discuss that knowledge with each other, and relate it to knowledge gained from other courses.

Concept maps have been used for instruction in varied disciplines in the sciences as well as in the social sciences, and have also been used for teaching in the health professions. Because concept mapping engages students in knowledge construction, the assignment can encourage students to move beyond rote memorization, assist students in retaining knowledge, and equip students with a learning tool they may not already have in their repertoire. Students' concept maps can provide the instructor with useful information about the depth and organization of students' knowledge, and enable correction of misconceptions students may have. However, the value of concept mapping goes beyond improving students' organization of knowledge and assisting faculty members in improving their lectures. Given that pharmacy students are involved in the lengthy process of becoming knowledgeable, caring, and professional pharmacists, teaching strategies that encourage the integration of meaning and higher-level learning are valuable.

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Appendix 1. Scoring criteria for concept maps.

Scoring Criteria for Concept Maps

The emphasis in grading will be on the meaning group members have made from the subject material in the course and its inter-relationships.

Concepts Selected

Have meaningful concepts been selected from the course material?

- For each **meaningful, valid concept** included in the concept map, score 1 point.

Relationship Between Concepts

Is the meaning relationship between concepts indicated by connecting lines and linking word(s)?

Are the relationships valid? (Directional arrows are helpful in designating relationships.)

- For each **meaningful relationship** demonstrated in the concept map, score one point.

Hierarchy

Is the hierarchical relationship of concepts clear? Is each subordinate concept more specific and less general than the concept drawn above it? Is each subordinate concept relevant to the context of the subject material being mapped?

- Score 5 points for each valid level of hierarchy.

Cross-Links

Does the map show **meaningful interconnections** between one segment of the concept hierarchy and another segment? Is the **relationship shown significant and valid**?

- Score 10 points for each cross-link that is both valid and significant. Score only 2 points for each cross link that is valid but does not indicate a synthesis between sets of related of related concepts.

Examples

Are specific events or objects that are **valid examples** of a concept included? These should not be circled because they are not concepts.

- Score 1 point for each example

The Narrative

Relationship of Written Narrative to Concept Map

- Does the narrative explain how the map is structured and the decisions that you and your group made in constructing the map?
- Does the narrative integrate key concepts discussed in the course?
- If material is included from other courses in the P'1 year, is the relationship to communications in pharmacy practice made clear?
- Is the relationship between the narrative and the concept map clear?
- Use of correct grammar and punctuation will play a part in your grade for the narrative but to a lesser degree.

Relationship to Previous Knowledge

Does the narrative demonstrate how new material learned in this course relates to previous knowledge group members had prior to beginning the P'1 year? How have the materials covered in this course augmented, expanded, corrected, or changed your previous knowledge?

Narrative Score

Relationship of Narrative to Concept Map 80 points possible
Relationship to Previous Knowledge 20 points possible