
Assessment of critical thinking, problem solving and collaborative learning by utilizing a concept-mapping project within Pharmacotherapy course in Doctor-of-Pharmacy curriculum

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2

## Introduction – Course Description

- Pharmacotherapy III - Endocrinology, Gynecology, Urology
- Third therapeutics course in a seven-course sequence in the Doctor of Pharmacy Program
- Typically 100 students are enrolled in the class
- Principles of medicinal chemistry, pharmacology, and therapeutics are applied to the treatment of endocrinology, gynecology, and urology disorders
- Diabetes is a major focus of the course

3

## Pharmacotherapy III - Course Delivery

- Team Taught course
- Large classroom setting with an integrated teaching methodology
  - Lecture
  - Case-based
  - About 20% of the course is delivered as team-based and using active learning methods

4

## Replacing an exam in the course…

The idea of using a project based assignment started with …

- Fall 2018 curriculum planning meeting
- Plan to replace one exam with a web based – educational technology enhanced active learning assignment
- Objective was to promote creative and critical thinking, problem solving, communication and collaboration
- We came up with scholarly literature on use of concept maps in Pharmacotherapy to promote meaningful learning.

5

## What is a concept map?

- A concept map is a graphical and schematic representation of knowledge and concepts.
- It is based on the theory that we gain new knowledge by linking new concepts with our prior knowledge. Concept mapping is a very effective active learning tool that promotes in-depth learning rather than rote memorization.[1,2]
- There is a growing body of literature that has demonstrated benefits of using concept maps to engage students in meaningful learning.[1-5]

6

## Concept Map – Active learning strategy

- Active learning strategies engage the learners actively
  - Acquisition of knowledge
  - Promote learning, retention and improve learning experiences
- Active learning strategies are based on Constructivist Learning Theories

7

## Project Description

- Two phases:
  - Phase I: Creation of a general concept map for type 2 diabetes
  - Phase II: Creation of a second specific concept map based on a patient case
- Students to work individually and in groups:
  - Students work individually to create the individual map: develop clusters, define linkages and relationships
  - Students work in assigned groups to develop a collaborative concept map

8

## Concept Mapping- Phase I

- Create a general concept map specific to type 2 diabetes that *includes*:
  - Factors responsible for the development of type 2 diabetes
  - Underlying metabolic defects of type 2 diabetes
  - Macrovascular complications of type 2 diabetes
  - Guidelines and strategies for the prevention and treatment of diabetes complications
  - General goals for the treatment of patients with type 2 diabetes
  - Nonpharmacological and pharmacological treatment options

9

## Concept Mapping- Phase II

- Case Study
  - *Question: Map the interventions recommended for the prevention of CVD in patient with T2DM and multiple risk factors for CVD*
  - *Guidelines:*
    - Refer to the general concept map that the group has created
    - Highlight the conditions and treatment options on the general map (using red fill color) that apply to the patient case
    - Create a smaller, more specific concept map from the general concept map that clearly depicts the patient's case, conditions and individualized treatment plans

10

## Research Design

- Participants of this novel mixed-methods study were recruited from second-year PharmD students registered in Fall 2018 Pharmacotherapy III course.
- Concept-map development, web-tools, and assignments were introduced during a class session. An additional optional session on concept-map project was also offered.
- The patient case-based project was designed with individual and group-work components.
- A rubric was developed for assessing concept-map projects and in-class peer-group presentation of concept-maps.
- Student perceptions of using concept-maps as a learning-tool were obtained by pre-and-post Qualtrics surveys.
- Statistical analysis of exam performance on relevant content for the Fall 2018 students relative to Fall 2017 students was performed using SPSS.

11

## Introduction to concept maps

- Students were introduced to concept maps, the assignment and web based concept mapping tools in a class session.
- Free web based concept mapping tools like Lucid-Chart, Gliffy was introduced
- A follow up optional session on concept mapping tool and process was also offered.
- An instructional video was created and uploaded to Canvas to provide instructions to create a concept map using web tools and to explain the assignment
- An example of web based concept map was shared as a document and in the video
- The video also described the assignment and expected timeline in entirety

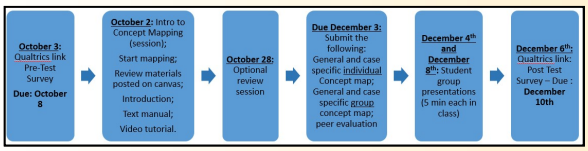
12

## Introduction to concept maps (continued)

- Students were expected to construct two concept maps related to the pathophysiology and treatment of diabetes and its complications;
- A general concept map of the content and a particular patient case-based map.
- 2 concept maps: (i) map created individually and (ii) working with their assigned groups.
- Peer evaluations of the group maps, were completed by the assigned peer-groups using a rubric developed by the faculty.

13

## Assignment Timeline




14

## Data and Analysis

- Pre and post concept-map assignment survey were used to gather student feedback on the learning process with concept maps
- A total of 114 and 95 students participated in the pre- and post-Qualtrics surveys (response-rate 100% and 83.3% respectively).

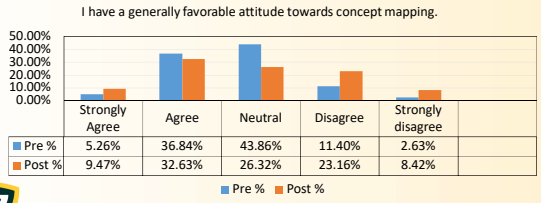
15

## Data and Analysis

- The survey results provided qualitative data that informed student perceptions
- The student performance on the exam based on the topic covered by the assignment was compared to the performance of the students in the previous cohort who did not experience the concept map assignment using independent samples t-test.

16

## Pre and Post Survey Data for attitude towards concept mapping - comparison




| | Strongly Agree | Agree | Neutral | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| Pre % | 5.26% | 36.84% | 43.86% | 11.40% | 2.63% |
| Post % | 9.47% | 32.63% | 26.32% | 23.16% | 8.42% |

17

## Student perceptions on Post Test

| Benefits of concept mapping project from post survey | SA/A |
|---|---|
| Concept maps helped me improve content knowledge organization. | 50.5% |
| Using concept maps helped me identify links and relationships between new information and my prior knowledge. | 55.8% |
| Developing concept maps helped me conceptualize the broad picture of pharmacological and non-pharmacological treatment for type 2 diabetes | 49.4% |
| I have enjoyed collaborative learning and working with my group for the concept map assignment. | 52.6% |

18

## Quantitative Data Analysis

**T- Test**

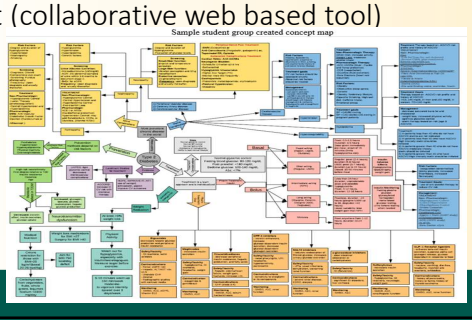
**Group Statistics**

| | Year | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Final score | 2018 | 113 | 86.0849 | 5.13835 | .48338 |
| | 2017 | 100 | 83.9939 | 7.14309 | .71431 |

The significance value for t-test for Equal Variances not assumed for independent samples test= 0.016 < 0.05, hence indicates that there is a significant difference in performance in the two groups 2017 and 2018.
Students in 2018 cohort performed significantly better on the content exam than the 2017 cohort.

19

## A sample student project created with Lucid Chart (collaborative web based tool)




20

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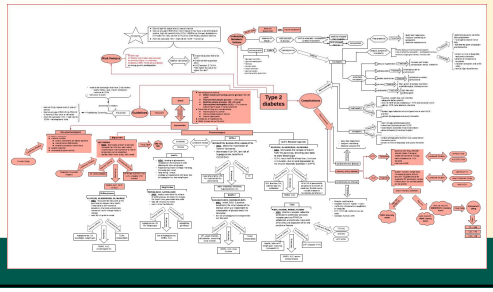


21

## Conclusions

- Most students reported positive benefits of concept map project for collaborative learning, identifying relationships and viewing the broad picture (problem solving and critical thinking) and content knowledge organization.
- Concept-maps can be used as a novel teaching and active learning strategy to promote higher order learning skills.
- Group presentations and reflection on the project promotes development of communication skills and self assessment which are critical for learning and student success.

22

## Implications

- The Accreditation Council for Pharmacy Education (ACPE) recommends pharmacy programs to promote student learning in problem-solving, communication, creative-thinking/innovation and collaboration (Standards 3 and 4).
- Concept-maps can be used as a novel teaching and learning strategy to promote and assess problem-solving, creative-thinking, collaboration and communication-skills in the PharmD didactic curriculum.

23

## Reference


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- 5. Fischer K, Sullivan AM, Krupat E. Schwartzstein RM. Assessing the effectiveness of using mechanistic concept maps in case-based collaborative learning. *Academic Medicine* 2018; 11. [Epub ahead of print].


24