Introduction

For 20 years there has been a push to integrate the basic and clinical sciences in medical school curricula. Recently, studies have suggested that cognitive integration by the student is best achieved when the relationships between clinical and basic sciences are directly demonstrated. Concept mapping in response to a prompt, which adds students to a graph of relationships among clinical and basic science concepts, should provide explicit connections that lead to a deeper conceptual understanding of the material. We designed a study to test the hypothesis that concept mapping improves the ability of students to diagnostically discriminate between multiple endocrinopathies when compared to students who were provided with similar resources. We also looked to see if knowledge retention was correlated with concept mapping or the type of notes taken during studying.

Questions Addressed

- Do students who use concept mapping retain knowledge better?
- Does the type of resource affect the type of notes taken by the students?
- Do students who take integrated notes retain knowledge better?

Methods

The study was based on an experimental design developed by Kulasegaram et al. (2005) and was approved by the UNE IRB. Participants in the study were recruited from the first-year medical student class. The students who volunteered were divided into 3 groups based on their grade in the fall Osteopathic Medical Knowledge (OMK) course and were randomly assigned from each group to one of the three experimental groups. The average OMK grade between the three groups was not significantly different.

Students in each of three experimental groups were given a written resource about related clinical disorders associated with the hypothalamic-pituitary-adrenal axis, where the resource either had a basic science section followed by a clinical description of the disorders (BC group), or the same information that was rewritten so that the causal links between the basic science and clinical features of each of the disorders was explained (INT group) (Figure 1). A third group (BC- CMAP) was given the BC resource and was given a prompt to create a concept map to show the basic science mechanisms underlying the clinical presentations of the endocrinopathies.

Students were given an hour to study the material or create the concept map. Students were given a white board on which to create the concept map. These white boards were directed resources or take notes on a blank piece of paper which was supplied. All resources and notes were collected prior to the testing session and pictures of the concept maps were taken.

Factual comprehension and the ability to diagnostically discriminate between disorders were tested following the study session with a single memory test of facts about the disorders, Memory Test 1, and a test that used clinical vignettes to test clinical reasoning skills, Diagnostic Test 1. A week later, students were tested for their retention of the material. Because the questions on the second set of tests were only slight modifications of the questions from the Memory Test 1 and Diagnostic Test 1 and assessed the same concepts, the retention rates could be calculated as the percent of the questions that were correctly answered on the first tests, which were also answered correctly on the second tests.

Following the second testing session students were surveyed regarding their impressions of the study materials given, including if they thought concept mapping helped them learn the material.

Student notes taken during the study period were collected and reviewed by three of the investigators. These reviewers used a rating scale of 0-3 to describe and enumerate the type and quantity of notes each student took based on the categories listed in Table 1. The averages of these ratings are listed in Table 1. For the integration category, a rubric was used to quantify the amount of integration between basic and clinical concepts.

Resources

Figure 1. Focus: Synthesis skills—new basic science (BC) study concepts Integrated Basic Sciences and Clinical (INT) resource

Cushing syndrome (CS) is a disorder of Chronic Hypercortisolism (excessive glucocorticoids) and is characterized by a constellation of patient complaints including weight gain (particularly, in the face, upper back and torso), fatigue, easy bruising and physical and mood changes of从小, central obesity, buffalo hump, moon face, hypertension, non-pitting edema and proximal muscle weakness. Cortisol is the primary glucocorticoid and its effects are felt throughout virtually the entire body and impact several homeostatic mechanisms including appetite and extrathyroidal pathways. Excess glucocorticoids promote fat deposition, can suppress higher order brain functions, have anti-inflammatory properties and promote inflammation and degradative processes, providing substrates for increased visceral fat. Cushing’s disease is a pituitary adenoma expressing ACTH, and can be due to hyperadrenocorticism of the adrenal and pituitary glands.

Separate Basic Sciences and Clinical (BC) Formats

Cortisol is the primary glucocorticoid, expressed at the highest levels in the early morning, cortisol’s main function is to maintain homeostasis following fasting in the evening, including the effects of cortisol are felt throughout virtually the entire body and impact several homeostatic mechanisms including appetite and stress. Cortisol promotes higher order brain functions by inhibiting pain perception, memory consolidation, and extrathyroidal pathways. Cortisol has potent effects on appetite and energy metabolism, and increases appetite. It also has weak mineralocorticoid properties including sodium retention, and thus water retention, can chronically promote hypertension and weight gain.

Cushing syndrome (CS), or Cushing disease, is a disorder of chronic hypercortisolism (excessive glucocorticoids) due to multiple etiologies. The common etiologies that result in a state of hypercortisolism include the use of excessive glucocorticoids, tumors that secrete ACTH, such as pharyngeal carcinoma adenomas and rare ACTH secreting tumors (e.g., cutaneous tumors), and extrathyroidal tumors, such as salivary gland tumors. Cushing’s disease is the result of an adenoma in the pituitary gland expressing ACTH, and is characterized by chronic hypercortisolism. The primary glucocorticoid, cortisol, is expressed at the highest levels in the morning, and has strong effects on appetite and energy metabolism. Chronic Hypercortisolism (CHC) is characterized by a constellation of patient complaints including weight gain (particularly, in the face, upper back and torso), fatigue, easy bruising and physical and mood changes caused by tissue. Hypothalamic failure causes decreased secretion of CRH and ACTH, with loss of feedback inhibition of CRH and ACTH secretion. This combined with a weak pituitary response results in ACTH and cortisol secretion.

Representative response to: Did concept mapping help you learn the material?

- I don’t think concept mapping helped me very much because I was rushed. I think if I had more time, I would be able to learn the material rather than just focusing on putting things on the board.

Results

- In this study, concept mapping did not help immediate learning or retention.
- 14 of the 20 students who did concept mapping commented that they were not given enough time before or to complete the review map.
- There was no significant difference between the BC and INT groups on immediate learning, however the INT group had better retention in the Memory Test (p<0.05) but not the Diagnostic Test.

Do students who use concept mapping retain knowledge better?

Does the type of resource affect the type of notes taken by the students?

Table 1

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Figure 2. Test results on the Memory tests and Diagnostic tests of the three groups. Figure 2A shows the average score on the Memory Test 1 and Diagnostic Test 1. Figure 2B shows the retention rate for these groups on the second set of tests.

Figure 3. Test results on the Memory tests and Diagnostic tests of the 12 students with integrated notes (alone) and 12 Integrated group) were compared with test results of the 23 students with scores less than 1.5 (Non-integrated group). Figure 3A shows the average score of the Non-integrated and Integrated groups on the Memory Test 1 and Diagnostic Test 1. Figure 3B shows the retention rate for these two groups on the second set of tests.

Results

- The results of the Memory tests showed that students who took integrated notes had higher scores than those who took non-integrated notes. This difference was significant. The results of the Diagnostic tests showed a similar trend although the difference between the groups did not reach significance.

Conclusions

Our study suggests that the type of resources can influence the type of notes taken by students, and that the process of taking integrated notes can enhance learning and retention. This was a pilot study and is limited by a small sample size. Additional research is planned to confirm and expand on these results.

We are unable to draw any conclusions regarding the effects of concept mapping on learning due to the study design. It was clear that the students could not finish the concept mapping task within the time period, which significantly affected their performance on all of the tests.

References


