Student Perceptions of Integrated vs Separate Basic Science and Clinical Resources

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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 is achieved when the relationships between basic science and clinical domains are explicitly demonstrated. In order to investigate methods that promote cognitive integration we performed a pilot study to develop and test different learning resources. We then surveyed students' perceptions of these resources and analyzed how the resources affected their note taking.

Questions Addressed

- Does the type of resource affect the type of notes taken by the students?
- Do students have preferences for the type of learning resource?
- Do students who take integrated notes retain knowledge better?

Methods

The study was based on an experimental design developed by Kulasegaram et al., (2015) 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 5 groups based on their grade in the fall Osteopathic Medical Knowledge (OMK) course and were randomly assigned from each group to one of the two experimental groups. The average OMK grade between the two groups was not significantly different.

Students in each experimental group 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**). Students were given an hour to study the material. They were allowed to write directly on the resources or take notes on a blank piece of paper which was supplied. All resources and notes were collected prior to the testing session.

Factual comprehension and the ability to diagnostically discriminate between disorders was tested following the study session with a simple memory test of facts about the disorders (M1 test) and a test that used clinical vignettes to test clinical reasoning skills (D1 test). A week later, students were tested for their retention of the material. The questions on the second set of tests were slight modifications of the questions from the first tests and tested the same concepts (M2 and D2 tests).

Following the second testing session students were surveyed regarding their impressions of the resources.

Figure 1

Integrated Basic Science and Clinical (INT)

Excerpt

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 exam findings of moon facies, central obesity, buffalo hump, violaceous striae, hyperglycemia, hypertension, edema and proximal muscle weakness. Cortisol is the primary glucocorticoid and its effects are felt over virtually the entire body and impact several homeostatic mechanisms promoting anti-stress and anti-inflammatory pathways. Expressed at the highest levels in the early morning, cortisol promotes higher blood sugar levels by inhibiting peripheral glucose uptake and stimulating gluconeogenesis. Cortisol stimulates proteolysis, providing substrates for gluconeogenesis, but prolonged elevation can lead to peripheral muscle wasting and weakness. It also has weak mineralocorticoid properties inducing sodium retention and potassium excretion in the kidney. Cortisol also enhances the vasoconstrictive effects of catecholamines. This combined with its weak mineralocorticoid properties inducing sodium retention, and thus water retention, can chronically promote hypertension and weight gain.

The common etiologies that result in a state of hypercortisolism include the use of excessive exogenous glucocorticoids, tumors that secrete ACTH, such as pituitary corticotrophs adenomas and ectopic ACTH-secreting tumors (i.e. small cell lung cancer), and cortisol-secreting tumors, such as adrenocortical adenomas. Cortisol secretion from the adrenal cortex is regulated by the hypothalamic-pituitary-adrenal axis (HPA axis).

Separate Basic Science and Clinical (BC)

Excerpt

Cortisol is the primary glucocorticoid. Expressed at the highest levels in the early morning, cortisol's main function is to restore homeostasis following exposure to stress, including fasting. The effects of cortisol are felt over virtually the entire body and impact several homeostatic mechanisms promoting anti-stress and anti-inflammatory pathways. Cortisol promotes higher blood sugar levels by inhibiting peripheral glucose uptake and stimulating gluconeogenesis. Cortisol stimulates proteolysis, providing substrates for gluconeogenesis, and increases appetite. It also has weak mineralocorticoid properties inducing sodium retention and potassium excretion in the kidney and enhances the vasoconstrictive effects of catecholamines to increase blood pressure. In general, low levels of cortisol have the opposite physiological effects.

Cushing syndrome (CS) is a disorder of chronic hypercortisolism (excessive glucocorticoids) due to multiple etiologies. The common etiologies that result in a state of hypercortisolism include excessive exogenous glucocorticoids, pituitary corticotroph adenomas, ectopic ACTH secreting tumors (i.e. small cell lung cancer), and adrenocortical adenomas. Clinically, CS is characterized by a constellation of patient complaints including weight gain (particularly, in the face, upper back and torso), fatigue, and easy bruising. Physical exam findings typically include moon facies, central obesity, buffalo hump, violaceous striae, hyperglycemia, hypertension, edema and proximal muscle weakness. Hyperpigmentation may be a feature depending on the etiology.

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

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.** To quantify the amount of integration evident in the notes, each set of notes was rated on a scale of 0-3 using the rubric shown in **Figure 2a**. Examples of integrated notes and notes that were not integrated are shown in **Figures 2b** and **2c**.

Table 1

	Notes			Graphics			Integration
	Underline/highlight	Notes in margins	Outline/bullets	Tables	Pathways	Drawings	Based on rubric
BC	1.69	0.708	1.83	0.389	1.32	0.444	0.89
INT	1.41	0.912	2.24	0.279	1.31	0.324	1.35

Figure 2a

Integration

Cushing syndrome → excessive **Cortisol** secretion →

- Chronic **Proteolysis** → muscle wasting → **Muscle weakness**
- Increased **Sodium** and **Water retention** → increased **Blood volume** → **Hypertension** and **Edema** → **Weight gain**

Excessive **Cortisol** secretion → due to:

- **Exogenous glucocorticoid** → find in history
- **Adrenocortical adenoma** → increased **Cortisol** → represses secretion of **ACTH**
- **Pituitary corticotroph adenoma** → secretes **ACTH** → repressed by **Dexamethasone suppression test**
- **Ectopic ACTH-secreting tumor** → secretes **ACTH** → not repressed by **Dexamethasone suppression test**

Figure 2b

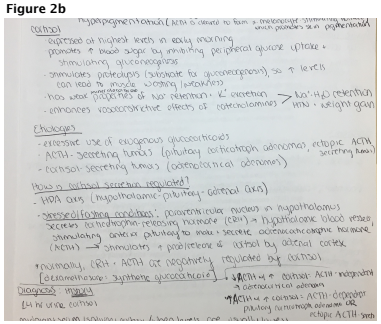
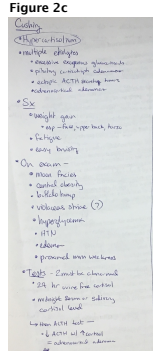


Figure 2c



Results and Conclusions

There were no significant differences between the groups regarding the quantity or type of notes they took. The notes of students in the INT group tended have more connections between the basic science and clinical concepts when compared with students in the BC group, however, the differences were not significant. Eight of 17 in the INT group had scores greater than 1.5 while only 4 of 18 in the BC group had scores greater than 1.5. This suggests that integrated resources promote integrated note taking and perhaps integrated thought processes.

Do students have preferences for the type of learning resource?

Immediately following the second set of tests students were surveyed regarding their impressions of the resources using SurveyMonkey. In the first survey question, students were asked to rate the resources using a 4-point rating scale. The results are shown in **Figure 3a**. Two open-ended questions followed in which students were asked what they liked about the resources and what could be improved. The open responses were coded and categorized into themes following guidelines as described by Patton (2002) by four of the investigators. The main themes that emerged are shown in **Figure 3b and 3c**.

Figure 3a: How would you rate the resources you were given to prepare for the tests?

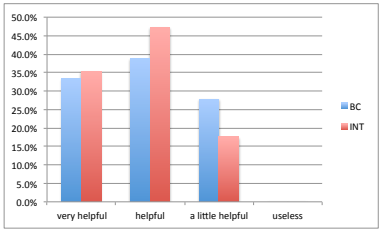


Figure 3b: What did you like about the resource material?

BC	INT
• Concise • Easy to read • Well organized • Sequence of normal physiology to pathology	• Concise • Integration of clinical material (improved engagement and understanding)

Figure 3c: What about the resource material could have been improved?

BC	INT
• Integration with clinical material • Organization using bullet points, graphics, tables	• Organization using bullet points, graphics and tables

Results and Conclusions

The responses from the two groups were similar and positive. The BC group felt the resources were concise and easy to read and liked the sequence of normal physiology to pathology. The INT group felt the material was concise and the integration of clinical and basic science material improved their engagement and understanding of the material. Both groups suggested that the resources would be better organized using bullet points, graphics and tables. A few in the BC group indicated that it would have been helpful to have the basic science material integrated with the clinical material. Overall, there was no strong preference for either type of resource.

Do students who take integrated notes retain knowledge better?

Test results on the Memory tests (M1 and M2) and Diagnostic tests (D1 and D2) of the 12 students with integrated note scores above 1.5 (Integrated group) were compared with test results of the 23 students with scores less than 1.5 (Non-Integrated group). **Figure 4A** shows the average score of the Non-Integrated and Integrated groups on the M1 and D1 tests. Because the questions on the M2 and D2 tests were only slight modifications of the questions from the M1 and D1 tests and assessed the same concepts, the retention rates could be calculated as the percent of the questions that were correctly answered on the M1 and D1 tests, which were also answered correctly on the M2 and D2 tests. **Figure 4B** shows the retention rate for these two groups on the M2 and D2 tests.

Figure 4a

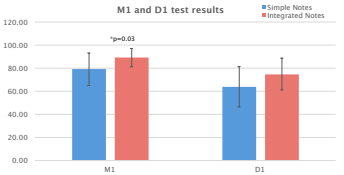
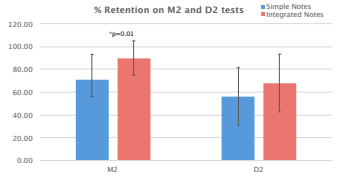


Figure 4b



Results and Conclusions

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. This suggests that integrated note taking facilitates learning and retention.

Conclusions

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

References

Kulasegaram, K., Manzone, J. C., Ku, C., Skye, A., Wadey, V., & Woods, N. N. (2015). Cause and Effect: Testing a Mechanism and Method for the Cognitive Integration of Basic Science. *Academic Medicine*, *90*, S63-S69.

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