Using Concept Mapping as Note Taking Strategies in Undergraduate Science Courses

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Abstract

Most undergraduate students take an introductory science course during their first two years. One of the challenges of teaching an introductory science course is the reality that many undergraduate students are not prepared to be self-directed learners. Many students expect to earn a grade of A or B just like in high school. However, the failing results of the first exam can be a shocker to the students. Not only the students do not know the science content they studied, they had difficulties retaining and recalling the information.

During the fall 2015 semester, the researchers assigned approximately 139 students within a Principles of Biology I (BIOL 1107) lecture course to one of the specific note taking category identified for this study -- Traditional note taking, Concept mapping, and Visual mapping. Students were asked to demonstrate their assigned note taking strategy in notebooks that were collected at the day of each unit exam. The notebooks were collected and reviewed based on demonstrated understanding of detailed content based on major concepts within a given unit. Demographic information (prior GPA, gender, earned credit hours, declared major) was used to check for correlation with the note taking strategy and exam averages.

Findings, based on quantitative data, showed no significance among note taking strategies and exam averages; however, students with a GPA of <3.0 following the traditional note taking strategy were not performing well on unit exams. Qualitative data, overall, suggests that the students found their specific note taking strategy to be beneficial, especially when it came to preparing for the cumulative final exam.

Introduction

Science education in general is heavily teacher centered (Brinkerhoff & Booth, 2013). It often relies on repetition and rote learning as well as exam averages as an indicator of knowledge learned. The problem lies within the fact that students do not know how to take notes; they often have difficulty recognizing key ideas or concepts.
Students also do not know how to study. It is easy for students to get overwhelmed when studying simply due to the amount of information written and documented in their notebooks. Without the proper organization of the amount of information collected could be daunting to even the most prestigious of scholars. Lastly, students lack the needed critical thinking skills especially in science courses (Hager, Sleet, Logan & Hooper, 2003; Rowe, Gillespie, Harris, Koether, Shannon & Rose, 2015). It is difficult for many students, especially, at the freshmen level, to apply what they are learning to the real world.

**Purpose and Research Questions**

The idea of concept or visual mapping as a note taking strategy was implemented to help students identify major concepts within a given unit and to easily make connections between or among major concepts. The researchers wanted to find out if implementing concept or visual mapping as a note taking strategy would help students retain and recall information throughout an entire semester of instruction.

**Methodology**

Concept maps are graphical tools for organizing and representing knowledge (Hay, Kinchin, Lygo-Baker, 2008; Novak, 2010; Sakiyo & Waziri, 2015). Major concepts are enclosed within circles or boxes and connections in the form of lines or arrows are used to demonstrate a connection between two related concepts. Along with the lines or arrows, one must include a descriptive linking relationship, further demonstrating the relationship between or among major concepts. Novak (2010) stated that concept maps are represented with a hierarchal or pyramidal structure with broad concepts located at the top and less general, or more specific, concepts located on the bottom. It is most helpful to construct concept maps in reference to a question. This allows organization of ideas and knowledge. A major goal of concept map construction is to reorganize existing knowledge with already acquired knowledge (Briscoe & LaMaster, 1991; Nesbit & Adesope, 2006; Patrick, 2011).

Visual maps are similar to concept maps; however, they are represented in a web format: broad concepts in the center and less general concepts branch from central concept (Hay, Kinchin, Lygo-Baker, 2008). Also, with visual mapping, very little text is involved. Rather than have a word or concept enclosed within a box or circle, visual maps require an image or drawing. The only text within a visual map should be the descriptive linking relationship between or among concepts.

Throughout the fall 2015 semester, 139 students, enrolled in two sections of BIOL 1107 from a southeastern state university, were asked to choose a note taking strategy to follow during the entire semester. About a third of the student population from each section were aligned with a note taking strategy. Color-coded, spiral-bound notebooks were provided to the students based on their specified note taking category: blue (traditional note taking), yellow (concept mapping), and green (visual mapping). The students were required to keep up with and update their notebooks all semester by organizing lecture notes based on their assigned note taking category.

On the day of each unit exam covering one or two chapters from the assigned textbook, notebooks were collected and graded. The total points awarded for the notebooks contributed 10% to the final grade. An undergraduate student research assistant was responsible for the task of reviewing all notebooks for content accuracy, awarding points using specified guidelines, and returning the notebooks to their respective student owners by the next lecture meeting. It should be noted that the research assistant is a biology undergraduate; therefore, she has extensive knowledge in the material she was reviewing.

Demographic data for all 139 students was also collected. Data considered included the student’s gender, major, and earned credits that were used later for data analysis.

**Participants**

BIOL 1107 is freshmen level course required by pre-nursing majors as well as science majors, in general. The course is worth a total of three credit hours plus an additional credit hour for the co-requisite lab. Of the 139 students, more than fifty percent were pre-nursing majors, followed by science majors (i.e. chemistry, geology, physics, or computer science). The remaining participants were non-science majors or undeclared majors.

**Data Collection and Strategies**

The fall 2015 semester of this course included four unit exams and a comprehensive final exam. On the day of each unit exams every student was required to turn in his/her notebook in order for it to be graded. The notebook
grading was completed by an undergraduate biology student with extensive knowledge in the material covered in the notebooks. She was responsible for ensuring that the information within the notebooks was accurate, making sure connections among major concepts were correct and relevant, and also ensured that the students followed the specific guidelines outlined by theirs specific note taking strategy. The research assistant then assigned a grade out of a possible 10 points and communicated this information to the instructor. Notebooks were then placed outside the instructor’s office door in order for the students to pick them up prior to the next scheduled lecture.

The student research assistant also compiled demographic information with the help of the lecture instructor. This way, it was easier to monitor any correlations among the students, their demographics, their exam scores, as well as their notebook grades. The student assistant kept track of all this information within Excel spreadsheets.

For the third and final exam, survey questions were included in order to generate honest, qualitative data. The responses were coded in order to ensure anonymity.

**Results**

At the end of the semester, the researchers found that there was no significant relationship among gender, major, prior credits earned with any of the note taking strategies. There was also no significant relationship for students who are freshmen or have GPAs above a B average in all note taking categories. However, the researchers did find a significant relationship between students following the traditional note taking strategy and have a GPA less than a B. It appears that students with less than a B average are not benefitting from the traditional note taking strategy based on their final average for the course (Table 1). Perhaps, as the researchers recommend, students with a GPA lower than a 3.0 should follow either the concept mapping strategy or visual mapping strategy in order to improve not only their exam averages, but also their overall knowledge of the material.

**Table 1. Prior GPA and note taking strategies.**

<table>
<thead>
<tr>
<th>Prior GPA</th>
<th>Note Taking Strategies</th>
<th>Mean</th>
<th>Standard Error</th>
<th>95% Confidence Interval</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshmen, First Semester</td>
<td>Concept Mapping</td>
<td>83.894</td>
<td>1.678</td>
<td>80.573</td>
<td>87.214</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Visual Mapping</td>
<td>81.617</td>
<td>2.056</td>
<td>77.550</td>
<td>85.684</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Traditional Note Taking</td>
<td>86.902</td>
<td>1.625</td>
<td>83.687</td>
<td>90.117</td>
<td></td>
</tr>
<tr>
<td>Prior GPA Below B</td>
<td>Concept Mapping</td>
<td>83.490</td>
<td>3.064</td>
<td>77.428</td>
<td>89.552</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Visual Mapping</td>
<td>80.802</td>
<td>3.064</td>
<td>74.740</td>
<td>86.864</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Traditional Note Taking</td>
<td>70.811</td>
<td>2.772</td>
<td>65.327</td>
<td>76.294</td>
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</tr>
<tr>
<td>Prior GPA Above B</td>
<td>Concept Mapping</td>
<td>83.687</td>
<td>3.475</td>
<td>76.813</td>
<td>90.561</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Visual Mapping</td>
<td>87.066</td>
<td>3.475</td>
<td>80.192</td>
<td>93.940</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Traditional Note Taking</td>
<td>86.959</td>
<td>2.457</td>
<td>82.098</td>
<td>91.819</td>
<td></td>
</tr>
</tbody>
</table>
Conclusion

Incorporating concept or visual mapping as note taking strategies does make a difference in student performance, especially with students having a GPA of a 3.0 or higher. In future semesters, the researchers plan design a better study that will demonstrate how the use of concept or visual mapping impacts comprehension, retention, and recall of relevant information.

For future semester, the researchers plan to make some changes in implementing similar research studies on note taking strategies. They plan to have more information available to the students on what is expected from them. They believe that this enhancement would improve students' understanding of the research activities. They plan to provide a detailed rubric for students to follow whether they are using concept mapping or visual mapping strategies. These rubrics would be discussed in detail on how the notebook submissions will be graded.

In rethinking the study for future implementation, the researchers had also decided to remove the traditional note taking as a submission option since it was learned that this strategy did not benefit students --- primarily those with below a B average. Lastly, the researchers plan to continue implementing other lessons learned from the past semesters in order to hone in on aspects of the study that were genuinely beneficial to the students. They believe in continuing the use of concept or visual mapping to find out more how these strategies benefit the students in comprehending, retaining, and recalling information from course texts and lectures.

References


