The effect of graphic organizers on science education: human body systems

Kristen Alana Antoine
Louisiana State University and Agricultural and Mechanical College, krantoine@gmail.com

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THE EFFECT OF GRAPHIC ORGANIZERS ON SCIENCE EDUCATION:
HUMAN BODY SYSTEMS

A Thesis

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
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in

The Department of Biological Sciences

by
Kristen Alana Antoine, NBCT
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ABSTRACT

The purpose of this research is to determine whether graphic organizers foster better student achievement in science classrooms than guided note taking with PowerPoint presentations. The study was quantitative. Using approximately 69 high school Biology I students, two body systems were taught using graphic organizers as the main lesson plan tool and two body systems were taught only using a guided notes lecture with PowerPoint. A pre-test and a post-test were administered for each body system studied. Student test scores were evaluated to determine whether knowledge gains differed between the two types of lessons. It was found that the use of graphic organizer instruction was significantly better for student achievement when compared to the use of PowerPoint instruction and that there was much more interaction between student and teacher during the graphic organizer lessons. The delivery of the lesson by the use of graphic organizers seemed to promote more student success than the use of the PowerPoint lesson.
INTRODUCTION

Educators are the main observers of student learning and retention on every level of the education process. Teachers are often able to pick up on student apathies toward content matter as well as methods of lesson presentation. Because of their extensive experience with observations of student learning trends many educators can be considered authorities in identification of classroom techniques that will be informative as well as interesting for students. Furthermore, educators can most effectively identify methods that will encourage student fascination with learning. A common issue that affects student achievement is lack of student reading ability and comprehension skills. “Many students admit that they don’t read very much-sometimes not even the required homework” (Billmeyer & Barton, 1998). The National Assessment of Educational Progress found that nearly half of preteen and teenage students surveyed reported reading less than 10 pages daily, including the required readings for their school work (Billmeyer & Barton, 1998). This is a problem overall but especially in the science classroom. Many students have problems with processing information, and teachers are always looking for innovative ways to spark student interest and increase student retention of the lessons presented (Billmeyer & Barton, 1998). Teachers are also looking for ways to incorporate differentiated instruction (see definition of terms) for students who have difficulty with reading and literacy. In the late 1970’s and early 1980’s the use of graphic organizers in the classroom surfaced in order to enhance learning, and the trend has continued into the present (Hyerle, 1996). Although graphic organizers have been given different names over these years (concept maps, concept diagrams, thinking maps, etc) they are similar in the way they are used in classroom education. Even though the names have changed and the way that they are used for specific subject matter teaching has improved, graphic organizers remain fundamentally the
same and are used in multiple subject matters and all grade levels to improve student learning and retention.

**Purpose and Significance of Study**

Graphic organizers are visual and graphic displays that depict the relationships between facts, terms, and or ideas within a learning task (Hyerle, 2000). These visual organizers have been linked to certain ways that information is to be presented and learned. “Visual organizers generate and unveil models of interrelationships developed by learners, along with the unique patterning capacity of each learner’s mind” (Hyerle, 2000). This tool is used to construct representations of information. This educational knowledge is used for remembering, communicating, and negotiating meanings between interrelated pieces of information. Visual tools are used to rediscover information, ideas and experiences that may have become cognitively disconnected. “Maps are used to find our way to new information, much like a treasure map of the mind for seeking new meaning in texts and other materials” (Hyerle, 2000).

It is important to determine the utility of the graphic organizers as learning tools for high school students because of their common use and because of the push by some school systems to use them.

Student comprehension is very important to science teachers as well (Billmeyer & Barton, 1998). Most students should be capable of grasping concepts if given the right tools. Graphic Organizers are tools that have been used for many years and have been changed to fit specific curricula, grade levels, subject matters, and lesson planning (Lee & Nelson, 2005). In this study these tools were tested on small groups of tenth grade biology students in a small school with a low socioeconomic status. The study is unique in that the researcher used multiple types of graphic organizers to teach specific lessons based on the human body systems.
The systems of the human body are an ideal set of topics with which to explore the value of graphic organizers because the human body is a topic in science that is often interesting and exciting for students. The knowledge of this topic will also be beneficial to all students regardless of their future ambitions. For the university and college bound students who show an interest in science or medicine, this topic will give them a good basis from which to build when they encounter anatomy in their post-secondary course work. On the other hand, for students who are not planning on participating in a science field after high school, it is important for them to have an in-depth understanding of their own bodies in order to stay healthy and function properly as they age. It is especially crucial for teenagers to become aware of their bodies and its changes because this is a time in their life where growth, change, and maturity are evident. This interest can be used to persuade students to create “big picture” concepts for the understanding of the various body systems that will be covered (Hyerle, 2000).

**Research Question**

Do graphic organizers foster better student achievement in science classrooms than guided note taking with PowerPoint presentations?

**Definition of Terms**

*Graphic Organizers*: Visual representation of the material a student is learning. The organizer allows students to brainstorm and organize information in order to connect ideas (Figure 1)

*Brainstorming*: Written decision making technique where the students jot down their thoughts about a particular topic in order to put them together in a way that makes sense

*Differentiated instruction*: The practice of modifying and adapting instruction, materials, content, student projects and products, and assessment to meet the learning needs of individual students
**High Yield Strategies:** Strategies that have been demonstrated through a combination of research and productive classroom practice as evidence that contributes to improved student learning

**Literacy Strategies:** Strategies that can be used by teachers in every content area to improve student literacy

**Thinking Maps:** Graphic organizers that use visual representations of information that aids in student problem solving and comprehension presented topics (Figure 4)
LITERATURE REVIEW

Reading Comprehension

In order for a learner to understand the information they have read, they must be able to comprehend the text. Teachers can begin by talking about the structure of the text that will be studied. There are a variety of graphic organizers that can be used to do this, and they can be done at any time during a lesson in order to help students understand what they have read (Forsten, 2003). Pre-reading activities like brainstorming ideas about background information can also aid in reading comprehension (Leary, 1999). These types of pre-reading activities can prepare students to understand text and also help to build their vocabulary and study skills (Jacobs, 2002). Teaching the use of metacognitive strategies (learning strategies that encourage higher order thinking and problem solving) can improve student reading comprehension (Howard, 2005). Learning is extremely effective when students can connect new information with past experiences. It is important to have a selection of learning strategies that can be used to master a new topic or skill. Teachers may use graphic organizers to prepare students for reading. Graphic organizers like comparison charts help many students to express ideas in a visible or perceptible way in order to process new information (Salinger, 2003). Teachers should give students a way to visually organize information for better reading comprehension during and after the lesson. They should aid students in bringing forth prior knowledge as well as developing linkages between prior knowledge and new information (Howard, 2005).

Graphic organizers have been found to enhance learning in at least three different ways. Prior to reading, they can be used to familiarize the reader with the information in the text as well as to allow students to acknowledge and share their understandings of the lesson objectives. They can also be used to enhance students’ prior knowledge of the topic being discussed.
Graphic organizers can readily display numerous interrelationships among concepts being presented and studied (West, 1991). By using this information teachers should be able to come up with different ways for students to respond to lecture and text and encourage student use of various organizational structures such as graphic organizers (Ruddell, 2001).

**Content Learning**

Creating a graphic organizer (Figure 1) for an instructional lesson plan is an effective way to get students involved in the learning process (Howard, 2005). When students are asked to help in lesson planning by suggesting questions they want answered about a topic and ideas they want to further explore, learning becomes a “community effort”. In this process, not only do teachers influence student thinking, but students influence teacher thinking. This interaction helps with sharing of decision making about context, structures, strategies, questions, and tasks (Lenz, Deshler, & Kissam, 2004). Graphic organizers have many uses in the classroom and can be used across the curriculum and in increasing patterns of complexity (Moore, 2003). Students are able to learn how to learn while they are in the process of gaining new knowledge. They are not only able to learn content but they are becoming readers that know how to ask questions while reading, construct images of ideas being conveyed in text, and summarize what is being read (West, 1991).

Webbing (See D in Figure 1) is one efficient way for activating prior content knowledge. As students come up with ideas, the teacher constructs a web representing how these ideas relate to the concept. The teacher then makes mental notes about what students know and what learning gaps need to be addressed (Howard, 2005). As the web develops, the teacher can add more information that students may have missed but that they need to know. Students can also refer to
the map during the lesson in order to make connections with the new information (Barton & Heidema, 2002). The primary function is to position several related terms, ideas, or concepts around one central element in a graphic or spatial organizer, then to help the students understand the relationships that link the different parts together (Howard, 2005).

Another efficient way of enhancing content knowledge is by using the “four square” as shown in Figure 2. This graphic organizer spatially represents the interrelationships of the concepts to students and aids in the combination of related ideas in innovative ways. A bonus for
using the “four square” procedure referred to above is that the process of creating them with or without the teacher can help with time constraints throughout the school day by using classroom time and student materials effectively and resourcefully (Brunn, 2002). Visual learning tools can also be types of node-link diagrams, such as the web diagram, where different shapes that represent the main ideas of the lesson link the lines that label the connection between main ideas (Howard, 2005). In these types of graphic forms, the cause and effect events are set in a chain link that show how each event added to the end result as shown in Figure 1. The composition of the nodes and links help to enhance instruction because they help students to understand the difficult passages in some readings (Ciardiello, 2002). Also, deciding to use a graphic organizer notebook, which consist of blank webs as seen in Figure 1 and organizers for students to complete after reading segments of content, in a content area unit is a useful tool for teachers to teach reading, writing, and study skill strategies for differentiated instruction to meets the needs of all students (Fisher, 2001). Use of different graphic organizers (Fig 1) allows thinkers, readers, and writers to transform ideas and concepts into a visual, graphic display that they can use for reading or writing assignments (Howard, 2005). Students get to see how the ideas they will learn about relates to their previous knowledge about the topic being studied. These organizers become idealized graphic representations of text structures. These graphic plans help students to form mental pictures of how texts are organized in order to better understand what they have learned (Sinatra, 2000).

One approach that has been used to overcome poor student reading comprehension is the use of external aids or displays like outlines and advanced organizers that are inserted in text to communicate which information is important and how it is structured (Howard, 2005). The graphic organizer is one type of extra display that was created to facilitate students in
understanding important inter-concept relations by presenting information spatially. These tools help to ease the grasping of information from texts that are read in a wide variety of settings (Robinson, 1998). Students can comprehend the concepts in content area studies better within the context of a graphic or spatial organizer, especially Frayer Model (Figure 2) vocabulary, than they can without the illustration of the concepts' components (Monroe, 1997). By creating a series of graphic organizers, teachers can make a significant difference in the vocabulary and contextual retention in their particular subject matters. In this study it was important to find out how relevant the use of graphic organizers would be for teaching concepts in the Science, particularly Biology, classroom. Most studies have been done in order to test the effects of these methods on reading and reading comprehension, which most people associate with English classes (Jacobs, 2002). This study is important in that it gives science teachers research-based information about graphic organizers that can be valuable for them and their particular lesson plan needs.

Figure 2: The “Four Square” is a type of graphic organizer (also known as the Frayer Model) that can be altered for vocabulary lessons based on the specific needs of the subject matter being taught.
Graphic organizers can be used to gain knowledge of relationships among concepts in a content area. Hierarchically organized graphics (Figure 3) require examination and explanation of content and seem to improve recall and transfer of learning. Hierarchical graphics require combination of content, which aids in problem-solving (Howard, 2005). While other characteristics of graphic techniques may affect learning outcomes, the primary differences will result from the types of cognitive processes that students go through while they are creating the graphics (Beissner, 1993). To lead students through a process of thinking about content, teachers can arrange simple graphic organizers in sequences that represent different levels of content cognition. It has also been found that visual organizers help students to take control of their own intellectual processes. Graphic organizers, which represent different kinds of thought patterns, allow teachers to focus student attention on higher order thinking skills while keeping their attention on the subject content being studied (Clarke, 1991). In specific classes tested learners constructed concept maps that reflected their understanding of science concepts better than traditional forms of testing (Novak, 1991). The results of another study suggested that the effect of concept mapping on science achievement appears to also have success with lower achieving students (Snead & Sneed, 2004). In a third study it was found that students who started with graphic organizers showed advanced achievement on their delayed post-test over the students beginning with a laboratory experiment only (Ritchie & Volkl, 2000). In all three studies, the students who used graphic organizers were able to apply text knowledge better than without. These results suggest that the method of presenting information, such as the usage of graphic organizers, played an important role in whether the student was able to understand the information presented during instruction.
In a study performed by Griffin, Malone, and Kameenui (1995) it was found that the performance of students who used graphic organizers was statistically superior to that of students in traditional instructional conditions. Encouraging outcomes have been reported when graphic organizers are used as both pre-lesson and post-lesson organizers (Moore and Readence, 1984). High school students who were taught concepts using specific concept diagram graphic organizers and concept teaching routines that complemented them showed gains in their performance on tests of these concepts (Bulgren, 1988).

**Hierarchical Organizer**

![Hierarchical Organizer](image)

Figure 3: Hierarchical Organizer used to help students see super ordinate and subordinate categories or ranks of a main topic or concept

**Literacy Strategies**

It is important that students are able to grasp science concepts that are presented to them, but this is sometimes difficult due to the literacy level of the students being taught. Incorporating literacy strategies into the daily lesson does two things: promotes the advancement of literacy in the student and enhances science learning of concepts. There are many different strategies that have been suggested to teachers in order to promote literacy across
the curriculum, but a large amount of them are visual tools such as graphic organizers. Examples of literacy strategies that are graphic organizers are the **Spider Map**, A in Figure 4, (used to describe a central idea: a thing, process, concept, or proposition with support); the **Series of Events Chain**, B in Figure 4, (used to describe the stages of something; the steps in a linear procedure; a sequence of events; or the goals, actions, and outcomes of a historical figure or character in a novel); the **Continuum Scale**, C in Figure 4, (used for time lines showing historical events or ages, degrees of something, shades of meaning, or ratings scales); the **Problem/Solution Outline**, D in Figure 4, (used to represent a problem, attempted solutions, and results); the **Fishbone**, E in Figure 4, (used to show the causal interaction of a complex event or complex phenomenon); and the **Network Tree**, F in Figure 4, (used to show causal information, a hierarchy, or branching procedures). (North Central Regional Educational Laboratory 1988).

**Construction of Graphic Organizers**

“A graphic organizer consists of spatial arrangements of words (or word groups) intended to represent the conceptual organization of text” (Stull & Mayer, 2007). The main purpose in all graphic organizers is to arrange words in such a way to organize text for a reader. There are large assortments of graphic organizers with a wide selection of patterns, shapes and formats that can be changed around by the learner and the teacher to fit the concept being taught (Chang, Sung, & Chen, 2002). Concept maps and graphic organizers can be created digitally with specific software, such as Inspiration and certain parts of ActivInspire. These allow students or teachers to link pictures and words within their maps adding more visual stimulation. In a study conducted by Stull and Mayer (2007), it was concluded that the increased activity of the learner, that of them physically creating the graphic organizer, should not be interpreted as deep learning. This means that it would be considered in the lower levels of Bloom’s Taxonomy but it would
Figure 4: Examples of “Thinking Maps” used to enhance classroom literacy strategies:
A. Spider Map  B. Series of Events Chain  C. Continuum Scale
D. Problem/Solution Outline  E. Fishbone  F. Network Tree
still be considered learning. Other studies have included that it is important, if not critical, to ensure that all students and instructors have been trained in the construction of any graphic organizers if they are going to be used in a particular classroom or lesson for knowledge retention (Chen et al. 2003; De Simone, 2007; Lee & Nelson, 2005; Taricani, 2007). It is important that students are comfortable with the form of the graphic organizer that is being used in the lesson presented.

Figure 5: Concept Definition Map- type of graphic organizer that provides a framework for organizing conceptual information in the process of defining a vocabulary term or an overall concept
How Graphic Organizers Can Improve Learning and Retention

The use of graphic organizers aids students in connecting newly gained knowledge to prior knowledge (McMackin & Witherell, 2005). Gholson and Craig (2006) commented on the importance of prior knowledge by saying, “Learners experience new phenomena, interpret experiences in terms of what they already know, reason about new experiences, reflect on experiences, and reflect on the reasoning process itself”. When discussing the activation of prior knowledge, it is suggested that when the student has the chance to link new concepts with ideas that they have already processed and stored in long-term memory, the student is granted an occasion in which to search for relationships which have been stored in the brain, making learning less complicated and more significant (Barton & Heidema, 2002).

It was suggested by Jenson (2005) that it is essential for teachers to be knowledgeable about how the brain makes sense out of information; therefore, it is very important to keep students in activities where they are made aware of the big picture. Zull (2002) shows us that abstract and theoretical ideas have insufficient meaning if no neuronal networks are stimulated by the learners’ own concrete experiences. When graphic organizers are used to create a structure of prior knowledge, the student has enough time to enhance his brain for the information he is about to learn. It is very important for the student to participate in the learning process, and no one can lend a hand with this duty better than the teacher. The teacher does this by modifying the lesson to where the learner must focus on prior knowledge. Graphic organizers provide signs that permit students to bring back information that has been stored in memory (Goddard et al. 2005). Stored information is connected to newly gained concepts, which creates relational knowledge that results in more robust comprehension (DiCecco and Gleason, 2002). As students review using a graphic organizer that has been studied in the past, the review causes
prior knowledge to be activated which has been stored in the student’s memory. Students are able to remember and discuss information as they visualize graphic organizers that have been committed to their memory (Ben-David, 2002). When prior knowledge is activated this is using graphic organizers, and studies have shown that comprehension of the material essentially increases over time (Katayama et al., 1997). The use of graphic organizers impacts student studying by providing them with a place to focus on how concepts are intertwined with each other instead of focusing on making specific associations or memorizing isolated conceptual facts (Chang, 2002). This visualization of the material helps the student to learn information in the curriculum overall instead of in pieces (Katayama et al., 1997).

**Visual Representations and Graphic Organizers**

Sensory abilities are powerful parts of the brain’s functioning. These abilities for learning using students’ senses can be used in the classroom to increase their understanding and preservation of information (Wolfe, 2001). Visual organizers aid the learners in the creation of knowledge based concept maps and connect otherwise disorganized information. This enables them to grasp and remerge information presented (Wolfe, 2001). Markowitz and Jensen (1999) observe, “Imposing a physical order on information or providing a logical framework for it makes it easier to remember”. Visual tools are now becoming key teaching, learning and assessing tools in many classrooms (Hyerle, 1996). When visual tools are fully introduced to students it means many things for the teacher. Students now have a solid way of grasping the key relationships built into the lesson, and teachers now are able to assess the student views of the information by viewing completed organizers. Visual tools also support a dialogue between students and teachers by having the representations visually displayed in front of them for discussion (Hyerle, 1996). It is also found that visual tools help to save students and teachers
time by giving the students more independent and meaningful work; giving teachers a quick way to assess student thinking patterns; and having students to be able to collect work samples that can be used as reviews for future large scale assessments (Hyerle, 1996).

Research is full of evidence that the human brain works best when information is presented through visual patterns. Students can retain information more if that information is being learned by linking together the information in some way (Billmeyer, 1998). Graphic organizers help students to make the links between new and previously acquired facts, between the new information that is being learned, and between stimuli that will be come upon in the future. They assist students in making those connections visually and physically (Hyerle, 1996). It has also been shown that by engaging visual processing centers in the brain this will cause other parts of the brain will be more fully engaged. This in turn allows for information to move more easily from short-term memory to long-term memory (Wolfe, 2001).
METHODOLOGY

Purpose Statement

Graphic organizers are visual and graphic displays that depict the relationships between facts, terms, and or ideas within a learning task. These visual organizers have been used effectively by educators to present and teach important concepts in their classrooms. This study addresses how graphic organizers affected the learning of science topics by high school students. Specifically, the human body is a topic in science that is often interesting and exciting for students. This interest can be used to motivate students to create “big picture” concepts for the understanding of the body systems. Student comprehension is very important to science teachers as well. Most regular education high school students should be capable of grasping concepts if given the right tools. Recently school districts have asked teachers to implement a new form of graphic organizers called “Thinking Maps”. “Thinking Maps” are a set of eight detailed graphic organizer maps that correspond to specific fundamental thinking processes (Leary, 1999). Significant resources have been spent on training and implementation for this system, but it is only a reemergence of a tool that has been used since the 60’s. The researcher was interested in how well the graphic organizer tool worked in general before implementation of the more specific form called “Thinking Maps” in the science classroom.

Participant Protection

The researcher completed the National Institutes of Health Human Subjects Certification online. The researcher also obtained permission from the principal of the school in which the research will be conducted. Forms were created, distributed and collected in order to obtain parent permission for all students under the age of eighteen whose scores were to be featured in the study. The identities of the students in this study were protected by generating unique codes.
for each student’s identification. This information was stored digitally and password protected.

This research was conducted for the Masters of Natural Science Program at Louisiana State University; therefore the researcher received an Institutional Review Board (IRB) exemption in order for the study to proceed.

Participants

Data were collected from high school students in southern Louisiana. In this school there were both middle and high school students. There were approximately 345 high school students and 226 middle School Students. The male to female ratio in the school was about 1:1 and the student to teacher ratio was 25:1. This school is considered to be a low socioeconomic school because 90% of the students receive free or reduced lunch. The racial make-up of this school is Hispanic (1%), African American (83%), and Caucasian (16%).

Instruments

The instruments used in this study were pre-tests and post-tests devised by text book software test makers along with teacher prepared graphic organizers (see Appendix A). Data organization and analysis were performed using Microsoft Excel software (Microsoft, U.S.); IBM SPSS Statistics software (IBM Corp., U.S.); InStat software (GraphPad Software Inc., LaJolla, CA); and Edu-Soft Grader Website software (Houghton Mifflin Harcourt Publishing Company, Boston, MA). The software that was used to create pre-tests and post-tests for analysis came from the Miller and Lavine Biology Textbook test generator. This was used in order to create a test that has demonstrated valid biology questions in relationship to the section being studied and used for research. The teacher provided the students with the “skeleton” of specific graphic organizers for each section studied so that the format was standardized across all
students. Microsoft Excel was used to record student data, to calculate pre and post test results, and additional data analysis.

**Experimental Design**

In this study the students were their own controls. Using approximately 69 high school Biology I students, two body systems were taught using graphic organizers as the main lesson plan tool and two body systems were taught only using a guided notes lecture with PowerPoint. A pre-test was devised for each body system using questions derived from previous years’ benchmark exams and textbook test generator software. These tests were administered to all biology students before teaching the subject matter for each system. Students were taught two lessons using graphic organizers throughout instruction without any traditional guided notes PowerPoint instruction, and students were taught two lessons using traditional guided notes lecture with PowerPoint only. The students were tested again using the same test questions after their lessons (the post-test). Then student test scores were evaluated to determine whether knowledge gains differed between lessons taught with graphic organizers only and lessons taught with traditional PowerPoint where the students received a guided notes sheet that corresponded to the presentation and lecture that was given by the teacher about the particular topic. These knowledge gains were calculated by subtracting individual student pre-tests scores from student post-test scores for each organ system taught in the study.

**Procedure**

Four chapters on Human Body Systems were chosen for this study (Table 1) and these chapters were taught during the second school semester that started in January 2013. Three high school Biology I classes were selected and the students were familiarized with graphic organizers throughout the school year prior to the actual study. The Miller and Lavine Biology
Textbook test generator was used to create the student pre-tests and post-tests, and the students were familiar with pre-testing prior to this time of year by receiving random pre-test and post-test models with other chapters during the beginning and middle of the Biology course. All classes were taught either by use of graphic organizers only or by using the traditional guided notes PowerPoint lecture only. In order to have students participate seriously in the pre-testing, they were given prizes based on how well they did on the test. A class average was taken for the pre-test scores and the class with the best pre-test averages was given some sort of treat. As they completed each chapter to post-test the students were given individual class recognition and possibly another treat was given for the class with the overall highest gain from the pre-tests to post-tests. There was also a display set up in the classroom (see Appendix B) where the students could visualize the results of their class pre-test and post-test in a large bar graph format. This reduced the problem of students not taking the pre-tests seriously and helped to motivate them to do their best on both tests. The researcher also gave a participation grade to students for completing their graphic organizers and participating in graphic organizer construction in class.

**TABLE 1: Systems Tested and Taught**

<table>
<thead>
<tr>
<th>Graphic Organizers</th>
<th>Traditional Power-Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skeletal System (1st)</td>
<td>Muscular System (2nd)</td>
</tr>
<tr>
<td>Nervous System (3rd)</td>
<td>Digestive System (4th)</td>
</tr>
</tbody>
</table>

Graphic Organizer Instruction Technique

The systems that were tested using graphic organizer instruction, skeletal system and nervous system, were both taught using the same procedure. Each of the systems was pre-tested on day one, prior to any teacher instruction. Following the pre-tests the students were introduced
to the topic by the “Academic Vocabulary” introduction model that they had followed for every topic throughout the school year. In the academic vocabulary model the students were given a term, like skeleton, and then played a short (about 3min) stimulus video in order for them to relate what they already knew to the new topic. Students were then asked to write their own personal definition for the topic. Once they had done this, the students together with the teacher compiled an accurate definition based on the correct parts of their personal definitions. Once this was complete the students drew a picture to relate it to the new topic.

On the following day the students were given a list of vocabulary words along with the teacher made “Frayer Model” sheet (Fig. 2) for each word (12-15 words). The students and teacher would complete a Frayer Model sheet for each word. During this time the teacher gave the definition for each word, then the students would give known details or examples about the word based on the definition. Next, the class would come up with a sentence that uses the word and makes it clear that they understand what the word means. Finally, all students would visualize the word and draw a related picture of their own.

Once the vocabulary was complete (after approximately 3 days of Frayer Model instruction) the students were given teacher-made concept maps to tie the vocabulary together. For example, for the nervous system students were given a hierarchical organizer (Fig. 3) that they used to sort the central and peripheral nervous systems into categories based on function. In this particular organizer, the main topic was linked to sub categories that related to how the different nervous system vocabulary words connected to one another and the students discussed the functions of the particular parts. This concept mapping to link vocabulary terms usually lasted for one day and was used to review and tie together all of the learned information from the
previous days. The students were then sent home to study their graphic organizers, and on the final day of the lesson the students were post-tested on that particular body system.

Power Point Instruction Technique

For the body systems that were taught using power-point instruction (muscular system and digestive system) the students were also pre-tested on day one, prior to any teacher instruction. Following the pre-tests the students were again introduced to the topic by the “Academic Vocabulary” introduction model that they had followed previously. On the second day of instruction the students were given a list of vocabulary words for the lesson, but now they were to use their text books to look up and define the words on the list. Once their definitions were copied completely and checked by the teacher for completeness, the students were given “guided notes” to accompany their vocabulary. The guided notes were the exact PowerPoint presentations that the teacher would be discussing, but with certain terms and sections omitted for students to fill in during teacher instruction.

The PowerPoint instruction usually lasted about four days. During this time the teacher would go through each power-point slide with the students and explain the concepts as the students took notes. When questions were raised by the students, the teacher would answer them and discuss the question and possible other explanation’s. If student discussion went beyond the information in the PowerPoint it was expounded on by the teacher. Once the PowerPoint instruction was complete the students were sent home to study their notes and vocabulary. The students were post-tested on that particular body system on the final day of the lesson.

Data Analysis

Using IBM SPSS Statistics software, Instat GraphPad software, and Edu-Soft Grader Website software the researcher calculated the learning gain for each student and determined the
mean learning gain for those who were taught using graphic organizers and those taught using PowerPoint traditional lecture methods. The Mann-Whitney test was used to compare the means to determine whether significant differences existed in the outcomes of the two methods. There was also a Kruskal-Wallis non-parametric test run on individual lessons of study to see other correlations. Only data from students present for both pre-tests and post-tests were included in the analysis.
RESULTS

Overall Analysis of Results

Descriptive statistics comparing the overall learning gains of student who were taught using graphic organizers and Power-Point lessons are reported. The results of the Mann-Whitney Test for the same information are in the table that follows along with the graph of the medians for both. All of the statistics were conducted using IBM SPSS Statistics software (IBM Corp., U.S.) and InStat software (GraphPad Software Inc., LaJolla, CA). The study was conducted with 69 tenth grade students who were pre-tested and post-tested in accordance to being taught for four lessons using either Graphic Organizers Only lessons or Power-Point Only lessons. Differences in student learning gains for each of the four lessons were examined for mean scaled scores.

TABLE 2: Means, Medians, and Standard Deviations for GO vs. PP

<table>
<thead>
<tr>
<th>Type of Instruction</th>
<th>Mean</th>
<th>Median</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graphic Organizers (n=114)</td>
<td>6.772</td>
<td>7</td>
<td>3.415</td>
</tr>
<tr>
<td>PowerPoint (n=111)</td>
<td>4.450</td>
<td>4</td>
<td>3.828</td>
</tr>
</tbody>
</table>

There was a significant difference between the learning gains for students taught using graphic organizer only instruction and the learning gains for students taught using power-point only instruction (Mann-Whitney U-test, P<.05). The difference between the medians for both values was considered extremely significant because the two-tailed P value was less than 0.0001.
Individual Lesson Comparisons

Once it was determined that there was a significant positive effect by graphic organizer instruction on student learning overall in comparison to PowerPoint instruction the researcher performed more analyses with other parts of the data in order to solidify her original findings. This test was performed to prove that the difference between the individual systems taught was directly linked to type of instruction as opposed to possible student apathy or interest in the particular topic. A Kruskal-Wallis non-parametric test was performed on the following sets of data.

In the table, the significance was shown using the Kruskal-Wallis non-parametric test to compare data for each body system studied. This was done in order to find out if the difference in learning gains could have possibly been caused by the subject matter taught. It was found that
in all of the cases where there was a graphic organizer lesson compared to a PowerPoint lesson that there was an extreme significance. But for the cases where PowerPoint lessons were

**TABLE 3:** Kruskal-Wallis non-parametric comparisons for significance of the learning gains between individual body systems tested in study

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Means</th>
<th>Medians</th>
<th>Standard Deviations</th>
<th>Two-tailed P-value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skeletal GO vs. Muscular PP</td>
<td>Skeletal=6.754</td>
<td>Skeletal=8</td>
<td>Skeletal=3.685</td>
<td>&lt;0.001</td>
<td>Significant</td>
</tr>
<tr>
<td></td>
<td>Muscular=1.981</td>
<td>Muscular=2</td>
<td>Muscular=2.791</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skeletal GO vs. Nervous GO</td>
<td>Skeletal=6.754</td>
<td>Skeletal=8</td>
<td>Skeletal=3.685</td>
<td>&gt;0.05</td>
<td>Not Significant</td>
</tr>
<tr>
<td></td>
<td>Nervous=6.789</td>
<td>Nervous=7</td>
<td>Nervous=3.155</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skeletal GO vs. Digestive PP</td>
<td>Skeletal=6.754</td>
<td>Skeletal=8</td>
<td>Skeletal=3.685</td>
<td>&lt;0.001</td>
<td>Significant</td>
</tr>
<tr>
<td></td>
<td>Digestive=3.000</td>
<td>Digestive=3</td>
<td>Digestive=3.183</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muscular PP vs. Nervous GO</td>
<td>Muscular=1.981</td>
<td>Muscular=2</td>
<td>Muscular=2.791</td>
<td>&lt;0.001</td>
<td>Significant</td>
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<tr>
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<td>Nervous=6.789</td>
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<td></td>
<td>Digestive=3.000</td>
<td>Digestive=3</td>
<td>Digestive=3.183</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
compared to other PowerPoint lesson there was no significant difference. The same was found for the cases where graphic organizer lessons were compared to other graphic organizer lessons. This reveals that the driving force for the difference between learning gains for all graphic organizer lessons compared the all PowerPoint lessons has validity in having an extreme significance. This also reveals that graphic organizer instruction produced more learning gain in student scores than PowerPoint instruction. The graph of the significance for all comparisons is shown below.

![Figure 7: Means and Standard Deviations for individual body systems](image)

**Honors vs. Regular Education Students**

The final analysis performed was comparing the learning gains for Honors Education students (HES) and Regular Education students (RES). Honors students are taught in separate Honors level class in which they would have had to have certain science prerequisites and
teacher approval to get scheduled for the class. Biology Honors class is more rigorous than the Biology Regular class. The Honors class consists of a more detailed study of the topics in Biology. There is more emphasis on laboratory exercises, class projects, readings, and independent study. The RES have the option to enter into the honors classes, but it will probably be more challenging for them. RES are currently performing at grade level for their Regular level classes. Some of them are slightly below average, but these students are usually “passing” students. For the research study both groups were taught in exactly the same way, but the researcher thought it may be interesting to see if there was a significant difference between the two populations of students for graphic organizer and PowerPoint instruction. Below are the results of these tests:

Graphic Organizers

In Table 4, the significance is shown for Mann-Whitney Test performed between each group of students when using graphic organizer instruction. The HES learning gains were significantly higher than that of the RES. The difference was considered significant because of a P-value equal to 0.0146. The P-value for the comparison is shown below.

<table>
<thead>
<tr>
<th>Graphic Organizers</th>
<th>Mean</th>
<th>Median</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Honors (n=46)</td>
<td>7.848</td>
<td>8</td>
<td>2.494</td>
</tr>
<tr>
<td>Regular (n=67)</td>
<td>6.000</td>
<td>7</td>
<td>3.774</td>
</tr>
</tbody>
</table>

TABLE 4: Comparison of Honors vs. Regular for graphic organizer instruction
PowerPoint

In the table below the significance is shown for Mann-Whitney Test performed between each group of students when using PowerPoint instruction. The honors students’ learning gains were statistically the same as that of the regular students. The difference was not considered significant because of a P-value equal to 0.09495. The P-value for the comparison is shown below.

Figure 8: Significance of Honors vs. Regular for graphic organizer instruction
TABLE 5: Comparison of Honors vs. Regular for PowerPoint instruction

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Honors (n=46)</td>
<td>2.630</td>
<td>2</td>
<td>2.585</td>
</tr>
<tr>
<td>Regular (n=69)</td>
<td>2.522</td>
<td>2</td>
<td>3.275</td>
</tr>
</tbody>
</table>

Figure 9: Significance of Honors vs. Regular for PowerPoint instruction
DISCUSSION

Statement of Results

The use of graphic organizer instruction was significantly better for student achievement when compared to the use of PowerPoint instruction. There was much more interaction between student and teacher during the graphic organizer lessons and this may have led to better student growth and understanding. It was also seen that the individual lessons showed about the same amount of gains for both graphic organizer lessons, but totally different gains between the graphic organizer lessons and PowerPoint lessons. This means that the subject matter was not as influential in student achievement as was the method of lesson delivery. The delivery of the lesson by the use of graphic organizers seemed to spark a lot of student attention and may have fostered more student success.

Reason for Study

This study was performed because of the numerous mandates by upper level school personnel to implement “new” classroom teaching techniques. Prior to the beginning of the study the researcher’s district administrators had come to the school proposing yet another new teaching strategy for implementation, and this was called Thinking Maps. The district had paid a lot of money to train literacy coaches and lead teachers to teach other staff members how to use these new strategies. All of the teaching staff members had also received large and very pricey training manuals to help with classroom implementation. Upon looking through the manual the researcher realized that these new Thinking Maps were only a collection of graphic organizers with new titles. The publishers of the Thinking Map model had only taken an old and widely used strategy and marketed them with a new name. At this point the researcher decided to find out for herself whether or not the use of graphic organizers, in any capacity, was really a better
classroom strategy than traditional classroom lecture. Being that the researcher had previously used graphic organizers in conjunction with PowerPoint lesson, she was anxious to find out if the use of graphic organizers for classroom instruction could essentially replace traditional PowerPoint lecture in certain instances so that teachers did not feel like implementation of a new strategy was an addition to their already stressful work.

**How the Results Fit with the Literature**

Much reading and research was done by the researcher prior to performing the study. The researcher found that there were many articles and papers that had been written related to the usage of graphic organizers in different educational capacities. Some of the most compelling and informative research materials came from papers written by Samuel Leary, Renee Ben-David, and Andrea Fisher.

In the study, *Enhancing Comprehension through Graphic Organizers*, (Ben-David, 2002) there was a comparison between graphic organizer lessons and assessment and linear note taking lessons and assessments. There were eight lessons that were studied and this was performed with 16 students that had special needs. In the results of the study it was found that there was no difference in the results for the student learning gains. For all research done the average was about the same. Ben-David mentioned that there possibly could have been a different outcome to the results if the population size of the students had been larger or if the study was done on general education students. The results from my study show that there was a difference between graphic organizer and traditional classroom lessons. In my study I used only traditional assessment, but I tested the type of instruction used. In this case there was a larger population size and my students were RES and HES. This literature increased the researcher’s awareness of
assessment methods as well as data collection size, which greatly enhanced the significance and methodology of the study.

The article, *Implementing Graphic Organizer Notebooks: The Art and Science of Teaching Content*, (Fisher, 2001) explained the various ways that graphic organizers could be used to enhance teacher lessons. In this study there was no definitive data to show student achievement, but Fisher made many classroom observations about student interest and progression. She found that this graphic organizer approach generated more classroom discussion, and promoted student achievement. In the results of my study it was also found that graphic organizer instruction generated more student involvement and promoted active learning. These things are all positive for student learning and achievement and the reflections of found in the Fisher 2001 study were very similar to the results found in my study.

The Leary study on Thinking Maps (1999) was one of the most influential papers in preparation for this study, but it too found that there was no significant difference in the use of Thinking Maps on student achievement for standardized tests. Leary’s study centered on the use of the Thinking Map techniques, but not necessarily the teaching interactions and student engagement that make graphic organizers work effectively. Just the use of graphic organizers without the teacher interaction and student participation would probably not yield a significant gain, but in my study the graphic organizers were not just used passively. The graphic organizer lesson was a whole exercise that incorporated student and teacher involvement. This method of teaching showed a significant gain in student achievement over PowerPoint lessons due to the production of student engagement and ownership.
**Limitations of Study**

As stated previously there was an obvious increase in student engagement when the graphic organizers were used. Students seemed to want to participate in the lesson more with these tools than with the PowerPoint lessons. Throughout lessons using both types of instruction the teacher attempted to hold student attention by asking questions and allowing opportunities for students to discuss information during the lesson, but the students participated more during the graphic organizer instruction on their own. The researcher was not in control of the actions of the students. This was a limitation of the study because the researcher was unable to determine if it was the increased active learning or the graphic organizer use that caused the students to perform better on their post-tests. The researcher suspects that the use of the graphic organizer instruction led to more student interaction which in turn led to better student performance.

**Active Learning**

Throughout the course of the research it was evident that the students responded well to involvement that graphic organizer instruction offered them. Many of the participants seemed to take the initiative to discuss and use higher order thinking in order to complete the parts of the graphic organizers that were required. In comparison to the PowerPoint instruction the students were much more drawn into the lesson, and they actively participated in classroom discussions and questions. The active learning and engagement by the students during the graphic organizer lessons seemed to promote higher order thinking. It also fostered more cooperative learning, access student subject matter familiarity, and student comprehension sharing, which ultimately led to more engagement and increased student learning gains.
**Student Excitement**

The evidence of student excitement when lessons were done with graphic organizers was very prominent after the first set of data was collected. Students were able to look at the back wall of the classroom and see on the large bar graph the amount of growth that they had attained. Many of the students automatically picked up on the apparent major growth that was plotted for the graphic organizer lessons as opposed to the much smaller growth graphed for the PowerPoint lessons. Students were very interested in continuing the graphic organizer lessons and were apathetic about doing the PowerPoint lessons. When the research study was complete the students voted to continue the rest of the school year lessons using graphic organizers instead of PowerPoint. Many students expressed to the researcher that they felt as though the graphic organizer lessons were more interactive, cooperative, and exciting. The students expressed that they took ownership in helping to create the graphic organizers during the lessons and that they felt this is why they had gained more knowledge.

**Perceived Intelligence (HES vs. RES)**

In the results section there was also a portion where the difference between HES and RES achievements were compared. When the study was being done most of the students assumed that the HES would have better pre-test scores than the other students, but this was not the case. In all pre-tests performed the students started off with basically the same amount of preexisting knowledge of the subject. It seems as if the HES only took better advantage of the opportunity for active learning and participation during the graphic organizer lessons which led to better post-test gains. It was found that when using graphic organizers the HES performed significantly better than the RES. On the other hand, there was no significant difference between the gains for the HES and RES for the PowerPoint instruction. The students seemed to show the
same amount of interest and engagement. Student perceived intelligence was not accurate. HES performed better on post-test for graphic organizers because of their increased involvement and discussion. Most students showed significant growth during the lessons taught by graphic organizer, but the HES benefitted more.

**Recommendations for Practice**

In classroom practice, graphic organizer instruction not only proved to result in significantly larger student learning gains but also encouraged more student lesson involvement and cut down on student lesson/lecture apathy. The researcher has decided to incorporate graphic organizer instruction fully in classroom practice for all lessons going forward. The use of the four square model was extremely student engaging and very user friendly. The researcher plans to use this model along with lecture in order to better explain vocabulary terms so that the students can use other types of graphic organizers to put everything together. In future practice the researcher will try different variations of the four square model as well as the use of many other graphic organizer models that will enhance the particular lesson being presented.

There are many ways that graphic organizers can be used in classroom practice. Throughout the course of this study the researcher found a multitude of different types of graphic organizers that could possibly be used for different topics in science. Even though the study focused on Human Body Systems, there are graphic organizers such as bubble maps and linear maps that can be used for topics like The Cell and Genetics. Many science topics are interrelated and must be linked in the learners’ minds. Graphic organizers help students to take somewhat complicated information and place it in a simpler format that is more understandable by the students. Examples of graphic organizers that will be implemented in future classroom practice
for all science topics are spider maps, Venn diagrams, tree maps, bubble maps, compare and contrast charts, T-charts, flow charts, and fish-bones (Fig. 1-5).

**Recommendations for Future Research**

Many researchers believe that the construction of the graphic organizer has a lot to do with the amount of student learning achieved. In some of the reading done prior to the study the researcher found that the instructions for particular graphic organizer implementation required that the students create their own organizer based on a teacher model. Students were required to physically draw out and fill in the graphic organizers on their own and then discuss which enhanced student involvement and cooperative learning. In my study, the researcher used graphic organizers that were teacher constructed and accompanied a teacher-led student assisted lesson. It would be very interesting in future research to find out if there is a difference between learning gains for student-created graphic organizer instruction and teacher-created graphic organizer instruction. In this future study, select topics would be pre-tested and post-tested to determine learning gains when graphic organizers are student-created with individual discussion and peer editing; and when graphic organizers are teacher-created with teacher led discussion and whole classroom instruction.
BIBLIOGRAPHY


APPENDIX A

Graphic Organizers Used in Study

Frayer Model Vocabulary Cards

<table>
<thead>
<tr>
<th>Definition:</th>
<th>Examples/Details:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bone Marrow</td>
<td>Central Nervous System</td>
</tr>
<tr>
<td>Soft tissue found in bone cavities</td>
<td>includes the brain and spinal cord</td>
</tr>
<tr>
<td>- yellow marrow: stores fat</td>
<td>- contains information received from the senses</td>
</tr>
<tr>
<td>- red marrow: makes red blood cells</td>
<td>- motor responses to be performed by the body</td>
</tr>
<tr>
<td>When I bit into an undercooked piece of chicken there was blood coming from the red bone marrow in the center.</td>
<td>The central nervous system is like the computer and modem for the body.</td>
</tr>
</tbody>
</table>

Concept Charts

<table>
<thead>
<tr>
<th>Structure</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerebrum</td>
<td></td>
</tr>
<tr>
<td>Cerebellum</td>
<td></td>
</tr>
<tr>
<td>Brain Stem</td>
<td></td>
</tr>
<tr>
<td>Thalamus</td>
<td></td>
</tr>
<tr>
<td>Hypothalamus</td>
<td></td>
</tr>
</tbody>
</table>
Series of Events Chains

System Labeling Diagrams
APPENDIX B

Classroom Motivation Wall
APPENDIX C

Institutional Review Board (I.R.B.) Approval Form

Application for Exemption from Institutional Oversight

Unless qualified as meeting the specific criteria for exemption from Institutional Review Board (I.R.B.) oversight, all LSU research projects using living humans as subjects or animals, or data obtained from humans directly or indirectly, without their consent, must be approved or reviewed in advance by the LSU I.R.B. This form helps the I.R.B. determine if a project may be exempted and to request an exemption.

Applicant: Please fill out the application in its entirety and include the completed application as well as the appropriate form below, when submitting to the I.R.B. Once the application is completed, please submit two copies of the completed application to the I.R.B. Office for review. Members of the I.R.B. can be found at https://www.lsu.edu/research/irb/approval-forms.html

A Complete Application includes all of the following:

1. Title of the project:
   - The Effect of Genetic Organizers on Science Education: Human Body Systems

2. Principal Investigator: Brianne Gleason
   - Title: Biological Sciences
   - Phone: 225-578-748
   - E-mail: brianne.gleason@lsu.edu

3. Co-Investigator(s) please include department, title, phone, and e-mail for each:
   - Kristen Arnone, M.A.T.
     - Biological Sciences Graduate Student
     - Phone: 225-578-748
     - E-mail: karen12345@gmail.com

4. Purpose (Yes or No): No
   - If Yes, LSU Proposal Number:

5. Subject pool (i.e., psychology students, high school students, etc.)
   - *Subjects are to be included in the study: children < 18, the mentally impaired, pregnant women, the elderly, etc. Projects with institutional review board approval are required to be exempted.

6. PI Signature:
   - [Signature]
   - Date: 6-17-2012
   - Number of signatures: 2

** I certify that my responses are accurate and complete. If the project scope or design is later changed, I will submit for review. I will obtain written approval from the Authorized Representative of all LSU institutions in which the study is conducted. I also understand that it is my responsibility to maintain copies of all documentation at LSU for three years after completion of the study. If I leave LSU before that time, the consent forms should be preserved in the Departmental Office.

Screening Committee Action:

Exempted [ ] Not Exempted [ ] Category/Paragraph [ ]

Reviewer: [Signature] Date: 7/9/17
VITA

Kristen Alana Antoine, a native of New Iberia, Louisiana, received her bachelor’s degree at Louisiana State University and A & M College in 2003. Going forward she taught high school science in New Iberia Louisiana where she attained the status as a Lead Teacher. After six years in the Iberia Parish School System she returned to Baton Rouge and started teaching high school science in Pride, Louisiana. During this time she completed her National Board Teaching Certification in Adolescent and Young Adult Biology. After a year in the East Baton Rouge Parish School System she applied to the LaMSTI (Louisiana Math and Science Teacher Institute) program at Louisiana State University in order to pursue a master’s degree in Natural Science. Upon acceptance into the program she began her work on her master’s degree thesis. During the time she was working on her degree at Louisiana State University she was also enrolled at Southern University and A & M College taking classes in Educational Leadership in order to prepare for the Louisiana School Leaders Licensure Assessment. She will receive her master’s degree from Louisiana State University in August 2013, and she plans to work on her Educational Specialist degree upon completion.