Effectiveness of Interactive Lectures Utilizing Diagrammatic Notes

in a High School Anatomy and Physiology Classroom

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ABSTRACT

Students respond differently to varying forms of material presentation. Due to differences in learning styles some students may prefer spoken information, diagrams or graphic organizers, written word or hands-on manipulation to help come to a solid understanding of course material. Teachers must present information in a manner that can reach each of the varying types of learners. The research investigates the effectiveness of interactive, diagrammatic lecture notes (picture notes) to present information in the high school anatomy and physiology classroom with an examination of the benefit to various learning groups. Data collection methods included comparisons of test scores, surveys and interview questionnaires. Findings suggest an increase in content comprehension and engagement with material as reported by students but are not represented by anticipated corresponding changes in test scores demonstrating an increase in comprehension or engagement with course material.
CHAPTER I
INTRODUCTION

Throughout the world, teachers toil to interest, motivate and inspire their students while passing along the required content knowledge of their discipline. Before beginning their practice, teachers often receive instruction in their teacher training programs about the different learning styles of students and how to reach all students. Multiple intelligences (Gardner, 1983) and discussions of the best strategies to use to meet the needs of all learners have been considered within each of the content areas in teacher training sessions, professional development sessions, conferences and workshops I have recently attended.

Researchers have also considered the best methods for learning in classrooms. Throughout the history of education varying methods have been employed to aid student understanding in classroom presentation and through reading of instructional materials. Through the guidance of researchers, teachers have taught their students to outline, concept map using a variety of methods including charts, graphic organizers, thinking maps (Hyerle, 1995) and roundhouse diagrams (Ward & Wandersee, 2002), and more recently researchers and teachers alike have contemplated the benefits of using a more active method of note-taking such as Cornell notes (Pauk, 1997; Marzano, Pickering & Pollock, 2004).

Keeping students engaged during material presentation while meeting the needs of all the different learners continues to be an area of concern in my own classroom. As a teacher of human anatomy and physiology to juniors and seniors at my high school, I must consider three issues during in-class instruction: 1) meeting the needs of the differing students as content knowledge is discussed, 2) helping my students be active participants in material presentation or learn how to keep themselves actively engaged in the material, and 3) preparing my students for
their educational continuation in college. Striving to attend to these needs and to prepare students for their continuing education, I find that I spend a portion of my instructional minutes used for presentation of content material in a lecture format as this is a commonly employed method by college professors. Knowing that this is not always the best way to meet the needs of all of my students as it caters primarily to those students who are strongly auditory learners, I have started using a series of interactive, pictorial presentations of material. In class, students are instructed in content material mainly through the use of diagrams and pictures, and as they reconstruct each diagram in their own notes we discuss the content material. Using this method, it is my desire that students receive the “lecture” preparation they will need to have practice with as they enter a college educational setting, but that material has also been presented in a more multimodal fashion.

Purpose Statement

The purpose of this research was to consider whether the use of interactive, pictorial representations of material, or “picture notes,” as my students refer to them, is an effective means through which to teach content material to the different learning styles in my classroom. In order to determine if picture notes are an effective teaching method I considered two aspects of effective teaching practices: 1) whether picture notes had any effect on the student’s level of comprehension and retention of material and 2) whether picture notes had any effect on the level of student’s engagement and interest (a level of motivation) in learning the material. I also focused on the differences in the learning of varying learning groups to determine if there was a variation in the experience for different groups of learners. Students were categorized into five learning groups: visual learners, auditory learners, reading learners, kinesthetic learners and weak auditory learners for the purposes of the study.
Importance of the Study

The information gained from this study allowed me to determine if the use of interactive pictorial representations in my classroom are an effective way of presenting information to human anatomy and physiology students. It allowed me to better structure the learning environment to meet the needs of the multiple learning styles found in my classroom. Through the examination of test scores and classroom surveys, the research also allowed some insight into whether students find this method of information presentation more engaging and interesting (or more motivational) than traditional verbal presentations. These findings may also be of use to other teachers who struggle to meet the needs of the multiple learning styles in their own classroom. This study allows other teachers to consider a different way of presenting information to the students in a way that may have a benefit in their own classroom.

Definition of Terms

“Picture notes” are flow charts, diagrams or pictorial representations of the structures and processes within the content for human anatomy and physiology. These concepts are presented sequentially using an overhead projector and multiple transparency overlays. Material is presented so that each part of the “picture” or process is revealed in a step-wise fashion on a transparency, each overlaying the last. Students are asked to copy the diagram, flow chart or picture onto their own notes and add information as discussed in class as they require for individual learning. Students are often given a “starter” page for each set of picture notes which is a beginning to the diagram they will end with. Students add to their starter page as the overheads are revealed in layers and portions of the material are discussed and/or analyzed at each step. At the conclusion of a class session, students end up with their own representation of the material as copied from the teacher’s overhead sample to which they have added color and
notes as they found necessary for knowledge and understanding through the discussion during the class period.

My picture notes are done in permanent marker (Sharpie or other permanent marker available in a variety of colors and tip sharpness) on overhead transparency prior to the class period. They can be used repeatedly throughout the day and for many years, without the need to re-draw diagrams each period. The use of permanent marker allows for the ink not to be transferred to fingers or accidentally rubbed off of the transparency. If an error is made in preparation or an adjustment needs to be made to the transparency, the marker will come off with acetone or acetone-based nail polish remover. As each new part of the structure or process is discussed, a new “layer” of transparency is added that shows the material currently being discussed. Students draw the part on their own notes and each adds additional information as each individual desires (see Appendix A).
CHAPTER II

REVIEW OF THE LITERATURE

In attempting to answer if interactive lecture utilizing a diagrammatic representation of the structures, functions and process taught in high school human anatomy and physiology are an effective means of presenting material and if this method effectively increases student motivation when compared to traditional lecture methods a range of literature topics were considered. First, I looked at the research and information available on the differing learning styles that students may have; here I placed a particular emphasis on the visual learner since it is my initial premise that this method may specifically have an increased benefit for this type of learner. I also reviewed the information that was available on diagrams and the uses as well as potential pitfalls that exist in their use in many educational fields, including education in the sciences. Finally, I considered the research on interactive lecture presentation and the potential motivational outcomes are reported by students when this type of presentation of material is used.

Different Learning Styles

People learn in many different ways and “students have preferences for the ways in which they receive information” (Lujan & DiCarlo, 2005, p. 13). This is important for teachers because by utilizing only a single style of teaching, a portion of our class may not be able to effectively learn and we may have lost these students. A learning style can be defined as an individual’s preference for the way that they receive, process, store and recall information that they are learning (James & Gardner, 1995; Lujan & DiCarlo, 2005). It is this complex process that explains why certain methods work better for some learners than others in our classrooms. If material is presented to a student in a way that allows the student to better understand and
process the information, then the student will be able to store that information and recall it as needed for activities, assessments, and future situations.

We are not all alike and each of us has individual preferences for the ways that we learn content material. “One characterization of learning styles is to define the learners’ preferred mode of learning in terms of the sensory modality by which they prefer to take in new information” (Lujan et al., 2005, p. 13). Neil Fleming and Charles Bonwell have categorized four modes of learning using our senses. These four categories include: visual, aural, reading/writing, kinesthetic; or VARK to use their acronym for the modes of learning. Using this categorization,

…visual learners learn through seeing drawings, pictures, and other image-rich teaching tools. Auditory learners learn by listening to lectures, exploring material through discussions, and talking through ideas. Reading/writing learners learn through interaction with textual materials, whereas kinesthetic learners learn through touching and experiences that emphasize doing, physical involvement, and manipulation of objects. (Lujan et al., 2005, p. 13)

Although individuals usually have a preference for one mode or another, it is important to know that people are usually not reliant on solely one mode of learning; “although learners can use all of these sensory modes of learning, one mode is often dominant and preferred” (Lujan et al., 2005, p. 13). Thus teachers, who are charged daily with the learning of their students, need to realize that as lessons are created to impart the content knowledge of our subject area, that each student carries a specific preference in the way to learn. These differing preferences must all be addressed in order to reach all students. In general, a multimodal approach that utilizes as many of the preferences as possible will allow material to be understood and processed by a greater number of our students.

Prigge (2002) stated that “setting up a successful classroom is one of the most important tasks educators undertake. The goal is to create an environment where all students can learn and thrive” (p. 237). As a part of her six ways to prepare the learner she identified the need to “teach
students about learning preferences” (p. 238). In order to accomplish this, it is important that different learning styles be discussed with the student and perhaps give the students an opportunity to take a learning styles inventory questionnaire to identify their preferred strategy. Students should also receive instruction in how best their brain receives, processes and even expresses information. Teaching students how they best manage new information allows each student to devise strategies themselves to best deal with information in the educational setting by capitalizing on their strengths in the classroom.

Visual Learners

Since it applies most to the research situation in my classroom practice, I am particularly focused on the potential improvement in the scores of the visual learners in my classroom. As a teacher, if I am presenting material strictly through the use of lecture (an auditory mode of content transfer) with the support of labs and inquiry activities (a kinesthetic mode of transfer) I may be overlooking those students who are very strong visual learners. Potentially, without the ability to properly understand and decipher the diagrams and charts in their texts on their own, (Henderson, 1999) these students could be “left behind” and therefore this group is the intentional target of my interactive diagrammatic lectures. “Visual learners remember best what they see, such as pictures, diagrams, flow charts, timelines, films, and demonstrations” (Clarke, Flaherty & Yankey, 2006, p. 218). The picture notes used in my classroom center around instruction that focuses on images, diagrams and flowcharts but are also presented along with discussion, an auditory method of learning, and since the students make drawings of their own, a kinesthetic method of learning.

The majority of the anatomy and physiology students are following an educational plan that leads them to a college educational setting. In the research I consulted, I found that in the
average college student population, more than 40% of students were visual learners (Clarke et al., 2006). Therefore, I need to be aware that a good portion of my class will likely learn best utilizing visual representations of material. “Because visual learners learn best through sight, pictorial depictions of the materials become central to memory” (Clarke et al., 2006, p. 219). This does not mean that they are all unable to learn using another teaching modality:

Most students are able to learn effectively as long as the teacher provides a blend of visual, auditory, reading/writing, and kinesthetic activities. However, some students prefer one of the modalities over the other three so strongly that they struggle to understand the subject matter unless special care is taken to present it in their preference mode. To meet these needs, teaching should be multisensory and filled with variety. (Lujan et al., 2006, p. 15)

Science material is an ideal subject for presentation to visual learners since so much of the material incorporates diagrammatic representation of structures and processes or functions can easily be arranged in to flow charts and timelines. All other modalities are also easily covered with lectures, lab activities and reading/writing assignments.

It is also important to remember that as the population of Los Angeles county becomes more diverse we begin to encounter more students in our schools and classrooms that are learning English as a second language. Until recently, this has not been a major concern of all teachers in the William S. Hart High School district, but it is becoming a more important focus for all schools within the district as our population is changing. “When working with ELLs [English Language Learners]…teachers need to increase the use of techniques that are less reliant on oral and written English to make information comprehensible. This is particularly important in junior and senior high school classrooms where concepts become more abstract and language more dense” (Carrier, 2006, p. 131). Some of the strategies that are encouraged for ELL students include many of the same strategies one would use with a visual learner including
the use of pictures, videos, graphic organizers and demonstrations as well as activities that are hands-on (Carrier, 2006).

Using Diagrams

As previously discussed, the use of diagrams is extremely important to the learning process of the visual learner. This comes in part due to “our mind’s eye-brain system [which] naturally seeks out these types of two-dimensional figures in the environment” (Ward & Wandersee, 2002, p. 577). Through the use of picture notes, material that could be presented to students in a written or auditory mode is presented visually through diagrams and flowcharts. Carrier (2006) says that “graphic organizers can be used in all the content areas to show relationships, comparisons, processes, causes and effects, and attributes of important information…Graphic organizers also present critical information in a format that is less visually intimidating that full text” (p. 134, 135). Presentation of material in a diagrammatic manner or through the use of flowcharts or other graphic organizer may help students to organize and reflect on information thereby increasing student comprehension of material and content learning.

Diagrams and other visual learning tools have been used successfully in the training of students in undergraduate principles of marketing courses (Clarke et al., 2006). The use of Roundhouse diagrams have positively impacted low-performing students in middle school science courses (Ward & Wandersee, 2002) and visual representations of material are recommended as appropriate strategies for teaching and assessing the content knowledge of students who are English language learners (Carrier, 2002). Since this strategy is effective for many different kinds of learners, college undergraduates to low-performing students, English
language learners and native speakers of English, it could be an effective teaching method in any classroom. Thereby, this increases the need to look at its effectiveness in my own classroom.

The research of Mayer, Mautone and Prothero (2002) compared learning by doing which is a concept that is reflected in the National Science Education Standards (National Research Council, 1996) and the use of pictorial aids versus verbal instruction within the concept of learning by doing. In their initial investigation the un-aided use of hands-on practice to learn by doing, “led to unsuccessful learning for many students,” (p. 172). Conversely, when the activity was repeated in their research following scaffolding the activity through prior instruction that included diagrams of the concepts, there existed “a positive effect on the accuracy and speed of solving problems,” (p. 177). The students who had received prior instruction using diagrams, “correctly solved more problems than students who did not receive pictorial scaffolding,” (p. 178-179). Through their research they determined that this result was true for two different learner groups: those who were low-spatial and high-spatial learners. This result showed that regardless of the student’s ability to comprehend spatial arrangement concepts, the use of diagrams in scaffolding the hands-on activity increased the understanding the students had in the modeling activity. This activity was also attempted after verbal forms of scaffolding and the same results were not obtained. Mayer et. al. (2002) summarizes their findings with this pattern: “pictorial scaffolding – which is predominantly visual – had a strong positive effect, but various forms of modeling – which are predominately verbal – did not,” (p. 180). This research demonstrated the value of the use of pictorial representations in scaffolding understanding within this activity, and may be true in many others.

Diagrams are not the panacea of education. I did find research discussing that teachers must be careful about the diagrams they use and the methods they employ when using these
representations for instruction in the classroom. Based on the assumption that diagrams make things easier to understand, they are frequently used by teachers but this usage may not always be effective (Henderson, 1999; Lowe, 1986). The research claimed that diagrams and pictorial representations are demanding constructions of material that require both skills and knowledge to interpret with accuracy and understanding. The use of symbols and lines on charts, diagrams or maps and the potential distraction of details in pictorial representations can make this method challenging for the learner (Henderson, 1999; Lowe, 1986). This research warned that teachers may understand these representations because of their pre-existing grasp of the material; students or learners, without this prior knowledge may need to be instructed in how to interpret and use the material contained in these representations. Henderson recommended in his research that teachers carefully explain what lines, symbols, shapes and colors of diagrams mean and that the diagrams not be used independently of verbal instruction in the classroom but rather simultaneously. Since the use of the diagrams is my actual presentation of the material therefore both visual and verbal, these topics will be addressed as the students complete their representations of the material in class.

Interactive Learning

According to Prigge (2002), one of the four ways to manage the environment of a classroom is to “create an interactive environment” (p. 238). This is an important strategy because this it engages the learner best. Interactive learning causes the brain to learn by doing rather than the traditional method of learning by merely listening and absorbing (Prigge, 2002; Ernst & Colthorpe, 2006; Hansen & Sefton, 2005). Learning is an active process (Ernst & Colthorpe, 2006; Michael & Modell, 2003) and can only be accomplished when the learner is engaged with the material; it is therefore the charge of the teacher to direct instruction in such a
way that student engagement is maintained. In addition, Ernst and Colthorpe (2006) stated that “it is clear from recent research that students prefer to be taught by interactive lectures,” (p. 41) and that this form of presentation “lead to increased student satisfaction and better learning outcomes” (p. 41). Research conducted by Sander, Stevenson, King and Coates (2000) which surveyed first-year university undergraduates about their expectations and preferences in college teaching, learning and assessment showed that “the teaching and learning method that appeared as the most preferred was the interactive lecture…(73%)” (p. 316). The research also revealed that one of the “most disliked teaching and learning methods were formal lectures,” (p. 317). Finally, this same group of students also believed that in college classrooms there would be less interactive lecturing than they would prefer. This research was interesting because it rather explicitly showed that students would prefer to be instructed through the use of interactive lectures and frequently found that this was not the case in many of their classes. It also revealed that students do not prefer to learn through traditional formal lectures which are frequently used by teachers.

Student Motivation

The method of information transfer is important because it can lead, at least in part, to the students’ desire to learn. Students who feel that they understand the information or who can engage in the learning process will find that they prefer the material and give it more of an effort. Clarke, Flaherty and Yankey (2006) state that “it is suggested that if the instructional technique is made compatible with a student’s learning style, they may learn more, retain information longer, and even possess a more positive attitude toward the subject matter” (p. 223). Lujan and DiCarlo make reference to this as well, “student motivation and performance improves when instruction is adapted to student learning preferences and styles” (p. 13). It is my desire that
utilizing a method that engages students in the material more than traditional lecture and a method that causes students to think about what they understand, more students will possess the motivation to perform better on the content material examinations in anatomy and physiology.
CHAPTER III

METHODOLOGY

Participants

This study involved the students in two of my classes in Saugus, California. The campus is one of six comprehensive high school campuses in the William S. Hart Union High School District. The school is located near the northern edge of Los Angeles County in the City of Santa Clarita, and serves primarily the residents of the Saugus and North Valencia areas. The City of Santa Clarita is the 24th largest city in the State of California; the fourth largest in the county of Los Angeles. In general, the population is upper-middle class (Spansel, Fricke & Hamburger, 2007). Demographics of the 2,593 students reveal that student ethnicity is 67% white, 20.9% Hispanic, 5.1% Asian/Pacific Islander, 2.4% African-American and .02% Filipino (Spansel et al., 2007). Figure 1 shows the reported division of student ethnicity on campus. Seventy-one percent of the student’s parents have completed some college or more; 11% of parents have post-graduate degrees (Spansel et al., 2007). The classes that were a part of this research study consisted of two elective classes of human anatomy and physiology students. Sixty percent of the students were in the eleventh grade and 40% were in twelfth grade. The average class size was 33 and the students were 55% female and 45% male.
Materials

To conduct this study, I compared the comprehension and retention and the students’ level of engagement and interest to content material presented with lecture (when material is presented verbally and supplemented with PowerPoint) to material presented with an emphasis on diagrams, illustrations, and a variety of graphic organizers (as “picture notes”). The PowerPoints, picture notes, and chapter tests were designed to align with the text. Both methods of notes shared much of the information and many of the diagrams as those presented in the text.

Procedures

The study ran for a 15 week period during the fall semester, between August and November 2007. The study incorporated four chapters (Ch. 1: Introduction to Anatomy and Physiology, Ch. 2: Chemical Basis of Life, Ch. 3: Cells, Ch. 4: Cellular Metabolism) of material presented utilizing traditional lecture methods and three chapters (Ch. 5: Tissues, Ch. 6: Integumentary System, Ch. 7: Skeletal System) of material presented in picture notes.

My study began by administering the VARK survey (Copyright Version 7.0 (2006) held by Charles C. Bonwell, Green Mountain Falls, Colorado 80819 U.S.A and Neil D. Fleming, Christchurch, New Zealand; see Appendix B) to the students in order to determine each student’s predominant learning style(s). Results of this study were used to break students up into five research groups: visual learners, auditory learners, kinesthetic learners, multiple learners and weak auditory learners. This was accomplished in order to study the effectiveness of picture notes vs. traditional presentation for several different learning groups.

At the completion of the study period, students completed a Likert scale survey and responded to a free response interview questionnaire to provide feedback on which they thought was a more effective method of learning and teaching. Both the survey and interview
questionnaire also included questions regarding student motivation during class presentation and whether they felt they were able to learn better with one method or another (see Appendix C).

**Analysis**

In order to categorize the students into learning groups, students were given the VARK learning styles inventory the first week of school in the 2007-2008 school year. Results from this inventory were used to place students into groups. Placement was determined by considering the highest category score on the learning styles inventory. Students who scored at least two points higher in one learning style than any other were placed into the category of the highest score. Students who did not have a clear learning style preference (i.e. students who had two or three scores within two points of another with no category that was two or more points above the rest) were placed in a multiple learning style category. For the purposes of this study, the multiple learning styles group scores were not used with the exception of the inclusion of their scores in “all students” categories. Through this process four groups were created. The VARK survey revealed that the visual learners were the largest single-learning style group with 21.9% of students fitting in this category. About 10.9% of the students were identified as kinesthetic learners, 7.8% were identified as auditory learners, and 4.7% as reading learners. The remaining 59.4% of students did not have one clear dominant learning style and were classified as multiple learning style students. The number of students in each category and a summary of the percent of students in each category of this study are seen in Table 1.

<table>
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<tr>
<th>Table 1</th>
<th>Categorization of Students by VARK Learning Styles Inventory</th>
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<tbody>
<tr>
<td></td>
<td>Visual Learner</td>
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<tr>
<td>Number</td>
<td>14</td>
</tr>
<tr>
<td>Percentage</td>
<td>21.9%</td>
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</table>
One additional category was created for thorough analysis of students who are at a disadvantage in traditional lecture formats. Students who scored at least two points lower as auditory learners than any of their other groups were placed into a group titled the “Weak Auditory” learner group. Six students qualified for inclusion into this study category, four of these students were also in other learning group categories, two were reading learners, one was a visual learner and one was a kinesthetic learner. The remaining two students in this group were categorized in the multiple learning styles group.

To analyze the data collected on the effectiveness of picture notes on the comprehension and understanding of the content material, I considered test scores, surveys and interview questionnaires. I compared mean test scores of material presented in each of the formats for each of the learning groups identified by the VARK survey. A t-test was also completed to find out if there was any statistical significance to the changes observed in the student’s scores. The survey asked students to rate, using a Likert scale, their perceived level of understanding and comprehension using picture notes and traditional lecture formats. Mean and mode survey scores are presented. Lastly, in the interview questionnaire, students were asked to respond to questions regarding their perceived level of understanding and comprehension in the varying presentation formats. Results from the survey and interview questionnaire are presented in tables and figures.

In order to analyze the data collected on the ability of students to engage with and focus on the material, I again used the mean test scores for material presented in different formats but largely relied on the responses generated from the surveys and questionnaires. Test scores were used to gauge students’ motivation to learn material and attentiveness to the material because material that students find motivating or material that students are more attentive to tend to lead to an increased test score. The survey was also used to rate motivation as it contained questions
asking students to rate, using a Likert scale, their ability to stay engaged and focused on material using picture notes and traditional lecture formats. Survey results were tallied and mean scores and mode score values were reported. Lastly, the questions in the interview questionnaire allowed students to respond questions regarding their perceived level of motivation and attentiveness during the different presentation formats. These results were also presented in table format.
CHAPTER IV

FINDINGS

This study was conducted to attempt to answer the following question: Are picture notes or traditional lecture presentations more effective in teaching anatomy and physiology content? In order to determine if picture notes are an effective teaching method I considered two aspects of effective teaching practices: 1) whether picture notes had any effect on the students’ level of comprehension and retention of material and 2) whether picture notes had any effect on the level of students’ engagement and interest (a level of motivation) in learning the material. In particular, I was interested in the potential benefit that the use of picture notes may have had on the visual learner, kinesthetic learner, and the weak auditory learner populations in the classroom. I was most interested in these groups because research in the literature review suggested that only a small portion of the students in the classroom are auditory learners, and a traditional lecture format of material presentation would be effective for only this group of students. I was interested to see if a different form of material presentation could be as effective as or possibly, more effective than traditional forms of presentation for a larger number of individuals in the classroom.

Comprehension and Retention of Material

In order to determine if picture notes increase the comprehension and retention of course material and therefore make them an effective method of material presentation, I used three methods of data collection: test scores, surveys and interview questionnaires. I considered the students’ test scores when the material was presented as lecture as compared to the test scores when material was presented utilizing primarily diagrams and pictures to determine if there was a change in the students’ level of comprehension and retention. Surveys were also given to the
students so that they could respond to how they viewed the effectiveness of pictures notes in comparison to other methods of presentation and the effect these methods have on their personal level of comprehension and retention of material. Lastly, interview questionnaires were given to students so that they could respond to the effectiveness both types of material presentation and how the different methods of presentation may affect their general understanding of the material and their ability to retain the information.

The study began in August 2007, the first week of the fall semester, with Chapter 1 and 2 covering the topics of introducing anatomy and physiology and a review of basic chemistry followed by Chapters 3 and 4 covering the topics of cells and cellular metabolism. These four chapters were presented in a lecture type format without the use of picture notes in the presentation of material. The results from each of the learning groups on the chapter tests on these sections are contained in Table 2. Overall student average on the Chapter 1 and 2 test was 78.7%, the average for the Chapter 3 and 4 test was 73.2%. The average test score for all students on these chapters was 76.0%. The individual learning groups varied from this value slightly. Learners whose strength was reading averaged 87.3% on these sections, weak auditory students were just behind at 86.7%, kinesthetic scored 84.1%, visual learners scored 75.9% and auditory learners, surprisingly, were the lowest average score at 74.9%.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Chapter Test Averages for Varying Learning Groups with Material Presented in a Traditional Format</th>
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<tbody>
<tr>
<td></td>
<td>Visual</td>
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<tr>
<td>Ch. 1 &amp; 2</td>
<td>78.4%</td>
</tr>
<tr>
<td>Ch. 3 &amp; 4</td>
<td>73.4%</td>
</tr>
<tr>
<td>Average</td>
<td>75.9%</td>
</tr>
</tbody>
</table>

The study continued with material from Chapter 5 on tissues (histology), Chapter 6 on the integumentary system and Chapter 7 on the skeletal system, which were presented utilizing picture notes in the presentation of material. The results for the chapter tests on these sections are
contained in Table 3. Overall student average on the Chapter 5 test was 74.3%, the average for Chapter 6 was 76.3% and the average for Chapter 7 was 73.6%. The average test score for all students on these chapters was 74.7%. Again, the individual learning groups varied from this value slightly. Learners who were weak auditory learners and kinesthetic learners did the best with a test average of 83.0%. Reading learners were just behind with an average of 82.0%, visual learners scored 77.5% and auditory learners were again the lowest with an average score of 70.0%.

This difference in the average percentage on the tests for each section of material was compared to analyze the effect the presentation method had on each of the learning groups identified for the study. Effects of the presentation style are presented in the table 4.

Of note in this research is that the visual learners are the only group to experience an increase in test scores during the unit of material taught utilizing picture notes as the method of presentation; the scores of the visual learners increased by 1.6% with picture notes. All other groups experienced a decrease in their score. The largest changes in test percentage existed in the auditory and reading learner groups. These groups had a negative percent change of 5.0% and 5.3% respectively. Overall, student test percentages decreased by 1.3% when the picture notes section of material began. Weak auditory learners’ scores remained relatively unchanged with a
A comparison of test scores is shown in Figure 2. When statistical analysis of the data was performed using a t-test, it is determined that there is no statistical significance to any of the changes witnessed in the student test scores. Using a p-value of less than 0.05 to determine significance, the closest group to showing a statistically significant change in mean test score is the reading learner group with a p-value of 0.28. The least significant data is found in the weak auditory group with a p-value of 0.97. T-test values are also contained in Table 4 on the previous page.

The second data collection tool to determine if picture notes increase the comprehension and retention of course material, therefore making picture notes an effective method of material presentation were student surveys. All students who began the study were also given a survey (see Appendix C) which asked students to rate, using a Likert scale, whether they felt that picture notes were an effective learning tool and whether picture notes increased their comprehension and retention of concepts learned in class. The scores on the Likert scale were converted to numerical values to determine the mean and mode scores (Yes = 4, Most of the Time = 3, Sometimes = 2, No = 1). The survey indicated that the majority of students find material presented in picture notes during anatomy and physiology class to be easier to understand and recall all or most of the time. A summary of some of the questions and mean and mode responses for each question are given in Table 5.
When asked if picture notes are a useful learning tool, 76% of students responded yes, 15% most of the time, 9% sometimes and none indicated a response of no. Percentages are represented in Figure 3. These results would indicate that 91% of the students in the anatomy and physiology classes find this method of presentation useful for learning material presented in class most or all of the time and 100% of students agree that picture notes are a useful learning tool at least some of the time. Similar results are obtained when students were asked if picture notes improved their comprehension of concepts in anatomy and physiology. Responses to this question indicated that 66% said yes, picture notes increased their comprehension, 21% most of the time, 13% some of the time and again, none of the sixty-one students who returned the survey gave the response of no. Percentages are represented in Figure 4. Here we find that 87% of students find picture notes improve their comprehension most or all of the time, and 100% agree that picture notes improve comprehension some of the time.

<table>
<thead>
<tr>
<th>Survey Question</th>
<th>Mean</th>
<th>Mode</th>
</tr>
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<tbody>
<tr>
<td>Do you think that picture notes are a useful learning tool?</td>
<td>3.64</td>
<td>4</td>
</tr>
<tr>
<td>Do you feel that you are better able to understand or recall the concepts...using picture notes?</td>
<td>3.25</td>
<td>4</td>
</tr>
<tr>
<td>Do you think picture notes improve comprehension of concepts in anatomy and physiology?</td>
<td>3.57</td>
<td>4</td>
</tr>
</tbody>
</table>

*4 = Yes, 3 = Most of the time, 2 = Some of the time, 1 = No*
The only question in this survey that indicates there may be some difficulties in comprehension and retention of material using picture notes was question four. This question asked students to rate their ability to understand and recall concepts presented using picture notes. Here I found that only 48% responded yes, 31% most of the time, 20% sometimes and 2% no. Percentages are represented in Figure 5. Although a lesser number of students responded yes, these numbers do still indicate that 78% of students experienced increased understanding and recall of concepts most of the time when they are presented using picture notes over traditional lecture and 98% agree that picture notes increased understanding and recall some of the time.

Finally, the survey asked students to rate picture notes as a useful method of presentation in anatomy and physiology and students overwhelmingly indicated that picture notes are useful. 93% of students rated picture notes as an eight or higher (on a scale to ten). Only four responses out of sixty-four, fell in the category of seven or below. The mean rated value was 8.9 and the mode was 9. Figure 6 shows the distribution of students’ rating of picture notes as a presentation method.
I chose not to analyze survey results independently for each learning group since the scores showed such a strong preference and support of picture notes as a presentation method. Since individual learning groups contained between three and fourteen students, it was determined that the responses of these small groups would not vary significantly from the responses found for the group as a whole.

The last tool that was used to determine if picture notes are an effective teaching method because they may have an affect on student comprehension and retention of material was an interview questionnaire. In the interview questionnaire, students were asked to describe how picture notes and traditional notes affect their comprehension of class material. Surveys were completed anonymously although a few students did include their name. Surveys were coded into categories; the most common categories are listed in Table 6.

<table>
<thead>
<tr>
<th>Sample Responses</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Picture notes allow visualization of material (to see it)</td>
<td>29</td>
</tr>
<tr>
<td>Picture notes increase understanding</td>
<td>28</td>
</tr>
<tr>
<td>Traditional notes allow me to understand functions/definitions better</td>
<td>7</td>
</tr>
<tr>
<td>Traditional notes are sometimes confusing or hard to understand</td>
<td>5</td>
</tr>
<tr>
<td>I prefer a balance of both picture and traditional notes</td>
<td>5</td>
</tr>
<tr>
<td>Picture notes help pull ideas and concepts together better</td>
<td>4</td>
</tr>
</tbody>
</table>

A sample of a student response indicating an increase in understanding is, “picture notes help me understand the material much better than traditional notes. It allows me to know where certain things are and if there is a process that goes on…[provides example]…drawing it out makes it easier to understand and follow.” Samples of student responses indicating an increased ability to visualize material is, “picture notes allow me to “see” what material I’m learning and actually understand the concept in depth. It helps me understand what goes where and why,” and also, “without picture notes I have a hard time visualizing in my head.” These types of responses were the most common which indicates that students feel an increase in comprehension because they
have a visual understanding of the material. Other respondents indicated the need to balance the types of presentation in class to increase student understanding of material or boasted of the benefits or expressed frustrations of one method of presentation or the other. Overall, most of the student interview questionnaires demonstrated that students feel picture notes positively affect their learning experience for material in anatomy and physiology.

Attentiveness and Engagement

To measure attentiveness and engagement (a measure of motivation), I again used test scores, surveys and interview questionnaires. I made the assumption that students would tend to do better on material that they were more attentive to or were more engaged with, so here I assumed that higher test scores for units taught in a traditional method or units taught with picture notes could be indicative of attentiveness and interest in learning the material. Surveys were also given to the students so that they could respond to how they viewed their attention and engagement with lessons presented in the differing formats. Lastly, interview questionnaires were given to students so that they could describe their personal or perceived class’ level of engagement and attention in class with different presentation methods.

The statistical analysis of test scores reported earlier indicated that there is no statistical significance to the differences seen in the scores to suggest that students paid more attention or were more engaged or motivated by the use of picture notes. None of the groups studied, nor the classes as a whole, experienced a significant change in their scores which would indicate a change in student motivation to learn the material.

The second data collection tool to determine if picture notes increase student attention and motivation, therefore making picture notes an effective method of material presentation was student surveys. Students were again asked to rate, using a Likert scale, whether they felt that
picture notes increased their ability to stay engaged and focus on material learned in class and whether or not they preferred the use of picture notes over traditional note-taking methods. Again, the scores on the Likert scale were converted to numerical values to determine the mean and mode scores (Yes = 4, Most of the Time = 3, Sometimes = 2, No = 1). The survey indicated that the majority of students find picture notes used in anatomy and physiology class to be more engaging and improved their focus. In addition, most students responded that they preferred picture notes to traditional methods. A summary of some of the questions and mean and mode responses for each question are given in Table 7.

When asked if students are better able to engage or stay focused on material presented with picture notes, 61% of students responded yes, 27% most of the time, 12% sometimes and none indicated a response of no. Percentages are represented in Figure 7. These results would indicate that 88% of the students in the anatomy and physiology classes find this method of presentation more engaging and indicate that they are better able to maintain focus. When asked if they prefer picture notes to traditional notes, 67% yes of students indicated that they did all of the time, 20% prefer picture notes most of the time, 10% sometimes and 3% indicated that they did not prefer picture notes to traditional notes. Percentages are represented in Figure 8 on the following page. This question indicates that 87% of students actually do prefer picture notes to traditional notes.
traditional note taking methods in class. Again, I chose not to analyze survey results independently for each learning group since the scores showed such a strong preference and support of picture notes as a presentation method.

The final tool that was used to determine if picture notes are an effective teaching method because they increase student attentiveness and engagement was an interview questionnaire. In the interview questionnaire, students were asked to anonymously describe how picture notes and traditional notes affect the level of attentiveness and engagement with class material. Surveys were coded; the most common categories are listed in Table 8.

<table>
<thead>
<tr>
<th>Sample Responses</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Picture notes help me to concentrate/pay attention longer</td>
<td>32</td>
</tr>
<tr>
<td>Picture notes are more interactive, I'm involved</td>
<td>17</td>
</tr>
<tr>
<td>Traditional notes do not keep my focus</td>
<td>9</td>
</tr>
<tr>
<td>Picture notes increase discussion and questions in class</td>
<td>8</td>
</tr>
<tr>
<td>Picture notes are fun</td>
<td>5</td>
</tr>
<tr>
<td>It is sometimes difficult to switch between picture notes and discussion of material</td>
<td>5</td>
</tr>
<tr>
<td>Traditional notes are boring</td>
<td>5</td>
</tr>
</tbody>
</table>

A sample of student responses indicating an increase in focus is, “with picture notes my brain is fully engaged with a picture, words and processing a structure’s physiology,” and “with traditional notes, I quickly write down the information and try to understand them later. However, picture notes push me to understand the information as I am taking them.” Samples of student responses indicating an increased engagement with the material is, “picture notes keep
me more attentive because there is more involvement during lectures,” and “picture notes greatly encourage me to stay focused and alert in class…the actual drawing…is more fun than writing. Because I look forward to the drawing, I engage more in the material,” These types of responses were the most common which indicates that students feel an increase in attentiveness and interaction with the material that is presented in class. Other respondents indicated the level of conversation and class discussion that changed when picture notes and traditional notes were used as a method of presentation. One student responded, “Traditional notes don’t stimulate students to ask as many questions as picture notes do thus making class engagement less during traditional notes.” Other students also mentioned how class discussion increased with the introduction of picture notes, indicating that students became more engaged and willing to discuss the material after the introduction of picture notes.

Overall, it appears that the majority of students find picture notes to be a more engaging presentation method that may increase student attentiveness in class. The interaction that students have with material during picture notes appears to be the primary reason for this response.
CHAPTER V
DISCUSSION

Overview of Study

The purpose of this study was to determine if utilizing picture notes, a teaching strategy that I employ in my classroom, are an effective teaching method. In particular, I compared the picture notes method I use to traditional methods of lecture presentation, since this is one of the methods that is commonly employed by teachers in upper level high school and college science classes. In order to determine if picture notes are an effective teaching strategy I considered two aspects of effective teaching practices: 1) whether picture notes had any effect on the student’s level of comprehension and retention of material and 2) whether picture notes had any effect on the level of student’s engagement and interest (a level of motivation) in learning the material.

In the studying picture notes to determine if they are an effective method of presentation, I considered students’ test scores throughout the study period with material presented utilizing traditional lecture methods and compared the scores to material presented using picture notes. Students also completed a survey and answered an interview questionnaire at the end of the study period on which they could reflect on the teaching methods and provide feedback and experiences.

Summary of Findings

The research in the study provided some interesting findings. A statistical analysis of test scores for a unit of material that was taught using traditional lecture methods and a unit of material that was taught using picture notes revealed that there was no significant change in the students’ scores. Despite the lack of significant statistical differences, the visual learners
experienced a slight increase in scores and other learning groups experienced a small decrease in their overall scores when material was presented using picture notes.

Survey and interview questionnaire results revealed strikingly different findings. Students claimed to have experienced increased understanding and comprehension when material was presented utilizing picture notes. In addition, survey results and interview questionnaire responses indicated that students may be more engaged and attentive to lecture when picture notes are the method of presentation for the material. Students made very strong comments in support of the use of picture notes in classroom presentations of material.

Conclusions

It is difficult to make any strong conclusions for, or against, picture notes being confirmed or denied as an effective method of material presentation from the results of this study. It is apparent from the survey and interview questions that students overwhelmingly seem to enjoy the picture note method of presentation and think that they not only better comprehend the material but that they are more engaged and attentive in class. Unfortunately, examinations of the test scores in this research do not seem to support this idea. I would say that since picture notes do not have a negative impact on the scores and since students find an increase in their level of comprehension, understanding and retention in addition to increasing engagement and interest in material, this method of material presentation can certainly not be an ineffective method of teaching. As teachers, one of our daily struggles is to keep students interested and motivated as well as to ensure their understanding and comprehension. This method of material presentation is certainly a viable option for teachers who are considering a different form of material presentation for their classes.
One interesting finding is that the visual learners actually did experience an increase in their overall scores and that they were the only group to experience this increase. Although the value did not reach a level of statistical significance, it is certainly a fascinating finding. For the visual learners to experience an increase that is not shared by any of the other groups holds a certain level of importance, and there is some indication that this method of presentation creates some benefit for the visual learner.

One other finding that was extremely interesting was the decrease in the reading learners’ scores. The three students in this learning group experienced a 5.3% decrease in their scores. These students, because of their learning preference, may have “missed out” because they did not have material that was primarily in a written format in their notes to read, review and practice before the test. The students did have a text book, but apparently may have chosen not to use that as a major study source before the tests. Another possible reason may be that one of the students in this group (#23282) became increasingly busy during the course of the semester with extra-curricular activities and reduced her studies because of a lack of time. Her scores alone, showed a large decrease as the end of the semester neared.

Possible implications of this study are that there are methods of teaching, such as picture notes, that are interesting to students and may not have been considered before. As teachers, any way that we can reach our students or that makes our presentation unique, interesting or engaging, therefore generating student interest, should be considered as a potential method of presentation. Teachers should be aware of how their population group learns best and design their lessons to reach the population of their classroom. This method gives teachers an alternative way of reaching their students.
Recommendations

In my own classroom, I will continue to use picture notes as a method of presentation since students find significant value in picture notes as a means of presentation. As a responsible educator, I will continue to be mindful that not all students learn best with picture notes and I will continue to seek out other ways to reach the learners under my charge. Through the use of many different activities, I will better be able to make my content tangible for all of the students in my classes.

This research should be considered by other teachers as well. It is important to remember to teach to all students and this doesn’t always mean how it would best be taught to you. If you are only using a single method of material presentation, chances are that some students may not be able to process the material to the best of their ability. Teachers need to work to reach all students or, at a minimum, to teach students how to use their learning strengths to process the course material.

Limitations of the Study

This study had many factors that may have hindered or affected the findings. Some of these limitations include: student reporting of learning style through the use of a single learning style diagnostic test, a comparison of test scores from completely different material sections and the assumption that the method of presentation is the only factor that may have impacted the student’s ability perform on the test.

The first factor that may have hindered or affected the findings is the student reported learning styles diagnostic test that was used. I chose to use only a single test to allow students to report their preferred learning style. A more accurate way to determine a student’s learning preference in a more thorough study would have been to use multiple questionnaires or to use the
same survey multiple times to verify the results that were obtained. Since students sometimes do not understand the questions asked on the survey, or often think of situations they have recently experienced when answering the survey questions, the results may actually vary from one survey period to the next. A more accurate determination of learning style groups could have been achieved by multiple surveys or questionnaires designed to measure learning style preferences or by administering the survey at two or three different times during the study period.

Another factor that may have hindered or affected the findings is a comparison of test scores from completely different material sections. The first four chapters presented utilizing a traditional lecture format, were also review chapters covering material that students had previously learned in biology classes. These chapters covered cell structure and function, basic biochemistry, DNA structure, transcription/translation, and cellular metabolism. These concepts were already familiar to my students, who took biology as a ninth grade science class. The next three chapters presented using picture notes, were chapters that covered primarily new material. These chapters covered the tissues (histology), integumentary system, and the skeletal system. These concepts were primarily new material of which the students had little scientific knowledge or understanding. It could already be presumed that the students would do better on the material in the first four chapters than they would do on the newer material of the remaining chapters. This is consistent with the results that were obtained. It may actually be an interesting finding that the students did score similarly on review material and new material when new material is presented using picture notes. A more effective way of completing this study would have been to teach one class with traditional lecture throughout the study period and compare the test scores of this class to a class that was taught with picture notes. This method would have allowed a more accurate evaluation of the effect of picture notes on the learning experienced by students.
The final factor that may have hindered or affected the findings of this study is the assumption that the method of presentation is the only factor that may have impacted the student’s ability to perform on the test(s). Students come to class every day with baggage that we are often unaware of. This baggage often include disagreements, discussions or concerns our students have with family, friends and peers, as well as many other issues including hunger, abuse, drug use or possibly even struggling with various learning disorders. This study assumes that all students are coming to class everyday without distractions and issues that may affect their ability to learn and process information, and that all students are capable of performing equally on the assessment for the chapter. In the case of this study, the assessment was a test for the chapter that consisted of 50 to 75 multiple choice, matching and labeling questions. This assessment format does not necessarily provide equal opportunity for all students. Between the assessment format used and knowing that all students are not always prepared to put aside their lives outside of class to learn, leads to an understanding that the teaching method cannot be the only factor that has influenced the students’ ability to perform on the test.

In addition, there were other factors on campus that created limitations during the study. Some of these limitations include things that as teachers, we are far too familiar with: students entering and leaving class during the study period, students missing important presentation days because of illness, athletic events, extracurricular programs and assemblies. Lastly there were changes in the study resulting from the need to present some information diagrammatically within the unit having no pictures due to a lack of student understanding with other forms of presentation.

As on any campus there were complications during the study period that limit the accuracy and potential of the study. These distractions result from students transferring into and
out of classes during the period of the study. Some of the students who began the study had moved to other campuses by the conclusion of the study period and others had moved into the study population after the beginning of the study period and missed the first half of the study. A changing study population has the potential to skew the results that are obtained.

Another complication to the study is the frequent absence of students for material that is presented in class. When this happens, students often copy notes from someone else in class, but this is an inferior substitution for being present for the material in class and taking your own notes. My study period was additionally impacted by absences as a result of the “Every Fifteen Minutes Program,” a school-wide program conducted in part by the Los Angeles County Sheriff’s Department, aimed at making students aware of the consequences of drinking and driving.

Lastly, a complication of the study that threatens the accuracy and potential of the study was the need to make changes in presentation methods during the study period. I found that several times during the unit of traditional lecture format, the students did not understand the concepts as presented. In my desire to make sure that students understand the material, despite my study, I presented some aspects of the material diagrammatically. Concepts such as osmotic pressure are difficult to explain, and for students to understand, without a visual representation. In these situations, I put my study aside for the benefit of my students’ comprehension and understanding of the material.

Despite its limitations, this study demonstrates a method of teaching that can be attempted and implemented in a great number of classes. With few exceptions, this method of teaching can benefit any level of student in any content area. The findings of this research showed an increase in the average test percentage achieved by the visual learners in the
classroom. Other groups of learners experienced a decrease in the average test score, but through
the use of many different methods in the classroom, teachers can better reach all students. This is
one method of presentation that may be used in reaching the visual learner in the classroom. It is
also important to remember that visual learners tend to be one of the largest groups in the
classroom. In my classroom almost 22% of the learners were categorized as visual learners, this
is one out of every four to five students in the classroom. If this method of material presentation
is effective for almost one quarter of the students in a classroom, it definitely should not be
discredited.

If I were to continue this study or repeat this research again in the future, I would make a
number of changes. First, I would research additional learning style inventories or administer the
same learning styles inventory at three separate times during the semester to gain a more
accurate assessment of the students’ learning styles. Second, I would restructure the research so
that one class was taught in a traditional format and other classes were taught with picture notes.
The classes could then be compared chapter by chapter against each other to determine
effectiveness of picture notes. This study could also be extended to other classes to see if picture
notes are effective in other content or subject areas.

Credits and Thanks

This is a teaching technique that I did not create. I learned the idea of picture notes from
another teacher, Mrs. Pamela King, who gave me some much-needed guidance when I first
began teaching the human anatomy and physiology course. At the time, my students were
struggling with understanding, comprehension and retention of the material, thus I reached out to
some of my colleagues for guidance and advice. Mrs. King eagerly helped me and provided me
with the basics and inspiration to begin creating my own course materials. As I have continued to
I teach human anatomy and physiology, I have borrowed many of her note ideas and constructed many new materials of my own that compliment my specific program. Many thanks to Mrs. King for her creative insight and the inspiration she provided me to try something new in order to achieve better understanding for my students.

I also find it necessary to thank my husband, Doug, and daughters, Dakota (12) and Riley (4), for their support throughout this program. Doug’s strength and encouragement have made the completion of this Master’s program possible especially when I became mentally and physically stressed to a breaking point. My husband and daughters have also unselfishly given me up for the last year and a half so that I could make it through this process. For all of this I am in awe of the love you have shown and can only say thank you.

In additional, I have to thank a few of my colleagues. A special thanks to Marissa Mullen and Marc Stephenson, my cohort peers, without whom I never would have made it through. You were always there to pick me up when I was down, drag me to class when I needed the encouragement and motivation, a shoulder to cry on when frustrated beyond belief and a help when the chaos of swim season was at its peak. Thanks also to Jim Klipfel, who continued to shoulder a larger than needed swim team burden while I finished up the final semester of course work. The Saugus family rocks!

Lastly, I must thank Dr. Rivas for his guidance and support. His great wisdom and patient direction have led me through a difficult process and to a product I can be extremely proud of.
References


Appendix A

Sample of Interactive, Diagrammatic Notes (AKA: Picture Notes)

Sample of “Starter page” on transparency
This page is often copied for students

Sample of second transparency page
Contains information and/or labels
Overlays the first transparency

Sample of third transparency page
Contains information and/or labels
Overlays the previous transparencies

Sample of fourth transparency page
Contains information and/or labels
Overlays the previous transparencies
Sample of fifth transparency page
Contains information and/or labels
Overlays the previous transparencies

Sample of sixth transparency page
Contains information and/or labels
Overlays the previous transparencies

Sample of seventh transparency page
Contains information and/or labels
Overlays the previous transparencies
Appendix B

VARK Learning Styles Questionnaire for Younger People

The VARK Questionnaire – for Younger People

Debra Jones, Coordinator of the University of California Gateways Project, wanted to develop a VARK questionnaire for high school students which has now been done. Sponsored by the University of California, Office of the President. The Gateways Project is an outreach project designed to reach "under-served students and assure their successful articulation to higher learning". This version of VARK is therefore modified for High School students. Debra anticipates using an online version of VARK with 30,000 students and the version is likely to be modified after these trials. Acknowledgment of this draft version should be made to Debra Jones, Cabrillo College, Aptos, California 95003 (831-476-5071), Charles C. Bonwell and Neil Fleming.

How Do I Learn Best?

This questionnaire aims to find out something about your preferences for the way you work with information. You will have a preferred learning style and one part of that learning style is your preference for the intake and output of ideas and information.

- Choose the answer which best explains your preference and circle the letter next to the answer.
- Please select more than one response if a single answer does not match your perception.
- Leave blank any question that does not apply, but try to answer at least 10 of the 13 questions.

1. When you have a few minutes with nothing better to do would you be more likely to:
   a. stare into space or doodle.
   b. talk to yourself or to others.
   c. pick something up to read.
   d. do something practical, like fix something or straighten up your room.

2. You are not sure whether a word should be spelled 'dependent' or 'dependant'. Do you?
   a. look it up in the dictionary.
   b. see the word in your mind and choose by the way it looks.
   c. sound it out in your mind.
   d. write both versions down on paper and choose one.

3. You want to plan a surprise party for your best friend’s birthday. Do you?
   a. talk about it on the phone with your other friends.
   b. make lists of what to do and what to buy.
   c. picture the party activities in your mind.
   d. invite friends and let it develop.

4. You are going to make or build something special for your family. Do you?
   a. make something without the need for instructions.
   b. thumb through some books and magazines looking for ideas.
   c. refer to a specific handbook where there are good instructions.
   d. talk it over with some friends.

5. You are really pleased with your acceptance for a summer program. This is also of interest to two friends. Do you?
   a. take them to see the program in action.
   b. show them the brochure and information you’ve found about it.
   c. start practising the activities you’ll be doing in the program.
   d. describe to your friends the activities you’ll be doing each day of the program.
6. You are about to buy a new CD player. Other than price, what would most influence your decision?
   a. the salesperson telling you about it.
   b. reading the details about it.
   c. playing with the controls and listening to it.
   d. it looks really nice and it is something you could picture in your room.

7. Recall a time in your life when you learned how to play a new board game or computer game. How did you learn best? By:
   a. watching others do it first
   b. reading instructions.
   c. listening to somebody explaining it.
   d. doing it or trying it for yourself.

8. After reading a play you need to do a project on it for your English class. Would you prefer to?
   a. read a speech from the play in front of the class.
   b. draw a poster showing something that happened in the play.
   c. act out a scene from the play.
   d. write your own review on the play

9. You are about to try to hook up your parent’s new computer. Would you first?
   a. unpack the box and start trying to put the pieces together.
   b. read the manual that comes with the computer.
   c. telephone a friend and ask questions about it.
   d. look at the pictures in the manual and on the box

10. You need to give directions to two friends to go to a house nearby. Do you:
    a. draw a map on a piece of paper.
    b. tell them the directions.
    c. write down the directions on a piece of paper.
    d. walk them over there yourself.

11. You have a problem with your knee and it hurts when you play your favourite sport. Would you prefer that the doctor:
    a. describe to you what is wrong.
    b. give you an article or brochure that explains the common problems with knees.
    c. show you a diagram of what is wrong.
    d. demonstrate with a model what is wrong.

12. A new movie has arrived in town. What would most influence your decision to go (or not go)?
    a. you hear friends talking about it
    b. you read what others say about it in a magazine.
    c. you see a preview of it.
    d. it is similar to others you have liked.

13. Do you prefer a teacher who likes to use?
    a. a textbook and handouts.
    b. diagrams, charts, pictures and slides.
    c. field trips, labs and hands-on sessions.
    d. Class discussions and guest speakers.
The VARK Questionnaire – Version for Younger People - Scoring Chart

Use the following scoring chart to find the VARK category that each of your answers corresponds to. Circle the letters that correspond to your answers.

e.g. If you answered b and c for question 3, circle R and V in the question 3 row.

<table>
<thead>
<tr>
<th>Question</th>
<th>a category</th>
<th>b category</th>
<th>c category</th>
<th>d category</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>A</td>
<td>R</td>
<td>V</td>
<td>K</td>
</tr>
</tbody>
</table>

Scoring Chart

<table>
<thead>
<tr>
<th>Question</th>
<th>a category</th>
<th>b category</th>
<th>c category</th>
<th>d category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>V</td>
<td>A</td>
<td>R</td>
<td>K</td>
</tr>
<tr>
<td>2</td>
<td>R</td>
<td>V</td>
<td>A</td>
<td>K</td>
</tr>
<tr>
<td>3</td>
<td>A</td>
<td>R</td>
<td>V</td>
<td>K</td>
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<tr>
<td>4</td>
<td>K</td>
<td>V</td>
<td>R</td>
<td>A</td>
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<td>5</td>
<td>V</td>
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<tr>
<td>6</td>
<td>A</td>
<td>R</td>
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<td>7</td>
<td>V</td>
<td>R</td>
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<td>9</td>
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<td>11</td>
<td>A</td>
<td>R</td>
<td>V</td>
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<tr>
<td>12</td>
<td>A</td>
<td>R</td>
<td>V</td>
<td>K</td>
</tr>
<tr>
<td>13</td>
<td>R</td>
<td>V</td>
<td>K</td>
<td>A</td>
</tr>
</tbody>
</table>

Calculating your scores

Count the number of each of the VARK letters you have circled to get your score for each VARK category.

Total number of Vs circled =
Total number of As circled =
Total number of Rs circled =
Total number of Ks circled =

Calculating your preferences

Use the “Scoring Instructions” sheet (available in the “advice to teachers” section of the VARK web site) to work out your VARK learning preferences.

Appendix C

Student Survey

Picture notes as a note-taking method in Anatomy and Physiology

1. According to the VARK learning styles survey taken in class, I found that I learn best through which method of learning:

<table>
<thead>
<tr>
<th>Visual</th>
<th>Auditory</th>
<th>Reading/Writing</th>
<th>Kinesthetic</th>
</tr>
</thead>
</table>

Comments:
__________________________________________________________________________________
__________________________________________________________________________________

2. Do you think that picture notes are a useful learning tool?

Yes  Most of the time  Sometimes  No

Comments:
__________________________________________________________________________________
__________________________________________________________________________________

3. Do you feel that you better engage or stay focused on material presented in the classroom when it is presented using diagrams/charts and/or pictures that are drawn yourself?

Yes  Most of the time  Sometimes  No

Comments:
__________________________________________________________________________________
__________________________________________________________________________________

4. Do you feel that you are better able to understand and recall the concepts presented when linked to the diagrams/charts and/or pictures that are drawn yourself?

Yes  Most of the time  Sometimes  No

Comments:
__________________________________________________________________________________
__________________________________________________________________________________

5. Do you think that picture-notes method of note taking when compared to traditional methods of notes improves your overall comprehension of concepts in anatomy and physiology?

Yes  Most of the time  Sometimes  No

Comments:
__________________________________________________________________________________
__________________________________________________________________________________

6. Do you prefer picture notes to traditional lecture and note-taking methods?

Yes  Most of the time  Sometimes  No

Comments:
__________________________________________________________________________________
__________________________________________________________________________________
7. Do you feel think that your understanding of material would be the same if the teacher presented the pictures with explanation during presentation but did not have you draw the subject matter?

Yes  Most of the time  Sometimes  No

Comments:

8. Even if your picture does not turn out exactly as the teacher’s, do you think that you can look back at your notes and understand the material as it was presented in class?

Yes  Most of the time  Sometimes  No

Comments:

9. What problems did you encounter while taking picture notes?

10. The most important thing I have learned doing picture notes is:

11. Note taking is an important skill to learn and CANNOT be eliminated from education but how can the educational system improve this process? Explain your ideas for improvement.

12. Within 10 minutes of presentation
   Traditional  Picture

13. At the end of the class period
   Traditional  Picture

14. The next day (during warm-up activity)
   Traditional  Picture

15. After 3 days
   Traditional  Picture

16. The day before the test
   Traditional  Picture

17. During the test
   Traditional  Picture

Indicate which method of note taking led to better understanding of the material presented at each of the different time frames listed below:

On a scale of 1 to 10, please rate the use of picture notes as a useful presentation method for material in anatomy and physiology.

1  2  3  4  5  6  7  8  9  10
This method is not useful at all  This method is extremely useful