The Role of Visual Representation in Nursing Students’ Understanding of Written Information: A Pilot Study

An Honors Project
Presented to the Honors Council of Carson-Newman College

In Partial Fulfillment of the Requirements of the Bachelor Degree of Science of Nursing with Honors

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The Role of Visual Representation in Nursing Student’s Understanding of Written Information

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Abstract

The purpose of this study was first and foremost to examine the effectiveness of traditional visual illustrations in helping students understand written material. The study was conducted as a quasi-experimental study with a post test. It tested Paivio’s theory of Dual Coding, which hypothesizes that information delivered via both the verbal and non-verbal routes is more effective in learning than information that uses only one of these routes. This study combined the verbal and non-verbal routes by pairing text with relevant illustrations in the experimental group. The results of the study were statistically insignificant, however some differences were noted in the means and ranges of the two groups, which may merit further study.
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CHAPTER I
INTRODUCTION

Twenty-first century science is carrying healthcare forward at an exponentially increasing rate and progress in nursing research is contributing growing amounts of data to the nursing body of knowledge. Nursing students in programs across the United States are under immense pressure to absorb greater and greater amounts of information (Bowles, 2006; Cherry & Jacob, 2008; Hoffman, 2008; Nobel, Miller & Heckman, 2006). Nurse educators are continually incorporating new diagnostic tests, new diseases, and new drugs into the nursing curricula, expanding the material necessary to establish an efficient knowledge base (Hoffman 2008).

This increased educational demand has been accompanied by new teaching materials in the nursing classroom. Interactive computer-based programs and computer-generated images are available to help students attempt to grasp the vast amount of information delivered in nursing programs (Day-Black and Watties-Daniels, 2006; Reed, 2006). A review of nursing literature, however, reveals a lack of studies exploring the traditional educational tools, such as reading, that still comprise the bulk of contemporary education (Hoffman, 2008). As educators strive to deliver increasing amounts of information to their classes, the methods of teaching these materials must be evaluated for efficacy and for possible areas of improvement to ensure optimal transmission, retention, and comprehension of material by the students (Noble et al, 2006; Zander 2007). Such information is valuable not only to those employing traditional methods, but to those creating and advancing newer or more complicated teaching methods as they seek to build on methods that have already proven useful.
The current body of research on the visual component of learning largely explores visual aids in assisting persons with disabilities (i.e. deafness, Down’s syndrome, cognitively impaired) in communicating (Gajria et al 2007; Montali & Lewandowski 1996; Wilkinson et al 2008). It also has attempted to analyze a mental thought process or cognitive paradigm when these tools are used (Kaiser et al, 2003; Plaisted et al 2003). These studies are explored further in the section of this project titled “Review of Literature.” This study on visual representation attempts to fill some of the gaps existing in the methodical examination of the current teaching methods by isolating the traditional two-dimensional illustration as an educational tool and exploring its impact of students’ ability to learn information.

**Education in the Nursing Classroom**

Education in the nursing classroom is traditionally structured around lecture and discussion (Bowles, 2006). Readings are assigned from textbooks that typically include some form(s) of illustrations to aid the student in understanding and retaining the textual information (Hoffman, 2008). Additional materials such as Power Points, audio and video clips, and advanced interactive technologies are working their way into the nursing curriculum with interactive tutorials, online resources and simulating technology (Carney and Levin, 2002). Research in progressive student-directed nursing education is advocating awareness of different learning styles and of the consequent adaptation of teaching methods to better accommodate a stylistically diverse student population (Black, 2004; Bowles, 2006; Felder and Brent, 2005; Noble et al, 2006; Pardue and Morgan, 2008; Walker et al, 2007). However, the tools used in traditional education have not been individually and thoroughly examined to determine their effectiveness.
Purpose of this Study

This study was conducted to determine whether the use of illustrations increases nursing students’ understanding of written information. In addition to providing information about the usefulness of illustrations in the learning experience, the study promoted awareness of the consequences of METH abuse, a growing concern in healthcare as well as in general society. The study involved research and subsequent compilation of an informational handout on a subject outside of the core nursing curriculum: METH-induced damage on the cellular level. Additionally, original illustrations were created by the researcher to compliment the handout and were included among the materials distributed to the experimental group. These materials are attached for review at the end of the study (Appendices C and D). A survey administered to the participants prior to distribution of the materials provided information about prior exposure to the METH education, allowing the success of the participants to be measured against their incoming familiarity with the material.

Research Question

The question that formed the basis for this study was “Do illustrations increase nursing students’ comprehension of written material?”

Theoretical Framework

This study is predominately based on a theory attributable to the field of educational psychology, Paivio’s Additivity hypothesis, which proposes that combining text with relevant illustrations (verbal and pictorial channels) promotes learning better than other methods that use only one channel or the other (Sadoski and Paivio, 2007). This study
applied this framework specifically to college students in an accredited Bachelor of Science in Nursing (BSN) program. (GDC)

**Paivio and the Theories of Dual Coding and Additivity**

Paivio proposes in his Dual Coding Theory that cognition in reading and writing consists of the activity of two separate coding systems of mental representation (Sadoski and Paivio, 2007). One system specializes in language (verbal) and one system specializes in nonverbal objects and events (images). Coding refers to the ways the external world is captured in those internal forms. The activation of representations within and between the systems is referred to as processing (Sadoski and Paivio, 2007).

Paivio’s cognitive theory of Dual Coding defines basic building blocks (representational units) of the verbal system *logogens*, or words (either spoken or written), and the basic representational units in the nonverbal system, *imagens*. Textbooks and educational literature frequently use both written words (logogens) and pictures/illustrations (imagens) to relay information to the reader. Paivio proposes that this method, which combines the verbal and non-verbal coding systems, enhances the reader’s learning abilities and retention to a greater degree than methods that use only one coding system, such as text with no illustrations, or audio and written words (Paivio and Sadoski, 2007). This idea that the combined use of both systems produces a greater benefit to the reader than either alone is Paivio’s theory of Additivity (Paivio and Sadoski, 2007). The concept of dual coding forms the theoretical framework for this study.

**Human Subjects**

Approval was obtained from the Internal Review Board of Carson-Newman College prior to study completion (Appendix F). The study was determined to pose little or no risk to
the students involved. A signed consent (Appendix A) was obtained from each participant prior to involvement in the study and no physical, mental or emotional harm was sustained by the participants.

The study was a psychological-non-manipulative study which evaluated the response of the subject to educational material. There was minimal risk to the participants in the study. The study induced little or no stress or discomfort except that which a student might feel in relation to being asked to perform on an academic level. Participants were informed that their performance during the study was in no way associated to or linked with their academic course work. Participants were also informed that any identifying information would be removed from data prior to analysis. In compliance with conditions of the Internal Review Board, possible risks to the participants were analyzed prior to the study. Participants were not harmed in any physical, mental, or emotional dimension.

Confidentiality

The identity of the study participants and the data that each contributed to the study was kept strictly confidential. Only the researcher and those involved in data collection and analysis had access to this information. Additionally, all of the data was devoid of participant identification to avoid possible bias when tallying scores. The only exception was that the participants were asked to place a number unique to each participant on the signed consent form and on the demographic survey, the handout, and the post test. This ensured that a participants’ data could be pulled from the study data if he or she decided to withdraw from the study. It also allowed the researcher to separate those participants who had fallen into the control groups from those in the experimental group, as the two groups were mixed together in the same room during the data collection. Data from this study will
be stored in a locked file in the advisor’s office for three years, at which point the data will be shredded.

**Recruiting Participants**

Participants were recruited by two professors of the Carson-Newman Nursing faculty, one who taught NURS 302 (Intro to Altered Health States) and one who taught NURS 203 (Pharmacology). An email announcement was sent out to the students and the study was announced in the classes prior to the date set for data collection. The subject matter of the information to be presented was acknowledged and the students were asked not to prepare for the study or seek out information concerning the proposed subject matter. Initially approximately eighteen (18) students indicated an interest or willingness to participate in the study. Eleven students actually participated in the study (n=11).
CHAPTER II

REVIEW OF LITERATURE

This study is essentially an educational study, specifically directed toward aiding nursing educators in the undergraduate setting. As such it combines the educational and nursing disciplines. Foundational research in information processing in educational learning, teaching methods, and tools is primarily associated with the field of educational psychology. Although this topic has carried over into all disciplines that emphasize education and learning, most educational research within other disciplines appears to build on the foundations established within educational psychology with subsequent differentiation.

Nursing Literature

The review of nursing literature for this study encompassed the last twenty years of published information and predominately explored published journal articles through electronic databases available to the researcher. Limitations were set so that the results of the search terms were limited to full text, peer-reviewed articles published within the last twenty years. A web-based search through generic search engines (i.e. Yahoo) was also conducted and the published works/books in the institution’s library were reviewed.

While abundant nursing literature incorporates visual elements into a paradigm of cognitive processing, its role was found to be mostly associated with data processing in individuals who experience some type of impairment, or among groups of persons that fall into a specific category (e.g. autistic, musical savant, blind, deaf, traumatic brain injury resulting in impaired mentation) (Gajria et al, 2007; Kaiser et al, 2003; Montali & Lewandowski, 1996; Plaisted et al, 2003; Wilkinson et al, 2008). These studies were
determined to be irrelevant to this study’s goal of evaluating illustrations as a learning tool in the non-impaired, competent college student. One study was found that evaluated illustrated handouts in teaching undereducated patients (Tymchuck et al, 2003). However, this study addressed education of undereducated lay persons (non-health professionals) rather than nursing students in continuing education.

**Educational Psychology Literature Review**

This review of literature in this area was conducted with less strict limitations regarding the publication dates of the materials. The materials found ranged from 1981 to 2002. Many studies have been conducted in the field of Educational Psychology on the effects of combined text and illustration on students’ learning, although the majority has dealt with young children or adolescents. Levin and Levin (1990) found that when combined with separate mnemonic illustrations for solidifying unfamiliar terminology and definitions, pictorial mnemonomy was found to facilitate students’ information reconstruction and application performance, both on immediate tests and on delayed tests up to 2 months later. David (1998) found that adding pictures to concrete news stories was more beneficial for memory and recall than adding pictures to abstract news stories. Fang (1996) supports the use of illustrations in children’s literature, proposing that pictures provide benefits such as motivation, increased creativity, mental scaffolds, and aesthetic appreciation. Reid and Beveridge (1990) conducted a computer-based experiment with 14-year-olds which dealt with illustrated science texts. The texts varied in complexity and the study found that the more difficult the text, the more the illustrations were referenced. In a study by Rubman and Waters, first graders demonstrated increased story recall when they were allowed to construct relevant pictures while listening to a story (2000).
Studies were also conducted among college students. Adler (1993) examined how different directions for processing representational pictures affected students’ recall of text information. College undergraduates were randomly assigned to one of four picture-processing instructions (e.g., determine how many objects are in this picture and write your answer in the space provided). Adler found a statistical advantage for the interrogative elaboration treatment, which demands answers to “why” or “what” questions. Benson (1995) conducted an experiment identifying potential problems with misinterpretation of combined text and illustrations in first year undergraduate biology students. David (1998) explored the role of pictures in news stories, using undergraduates as his sample group. He found a recall advantage for a text/picture combination when compared to a test-only combination. Ollerenshaw, et al (1997) found that undergraduate students provided with computer-simulated multimedia diagrams outperformed students in the other three categories (text only, text plus diagram with labels, and text plus diagram illustrating major operating stages) during a comprehension test on pump operation. Rummel, et al (2001) conducted a study which found that college students provided with mnemonic passages outperformed their study counterparts who were given “free-study” passages. Stone & Glock (1981) determined that college students who used text with pictures made fewer construction errors on an assembly task than those who used only text.

Many additional studies exist which will not be mentioned here due to space constraints. The literature review revealed, however, no studies conducted specifically within the health sciences.
Learning Theories in Education

Educational theories regarding learning and information processing abound. A few of the more prominent theories found in the literature are briefly considered here. Dunn and Dunn (1993) are noted for their work in the theory of Learning Styles, which proposes that a person has certain ways of gathering, concentrating, processing, internalizing and remembering new and difficult academic content (Dunn and Griggs, 2000). According to Dunn and Dunn (1993), the brain processes information in one of two ways: globally or analytically. Individuals who process globally tend to be holistic learners, requiring information in a larger framework (the bigger picture). Analytic processors require a detailed, sequential, step-by-step delivery before they can truly grasp the information being presented. In addition to a cognitive style, the Dunn and Dunn Learning Styles Model proposes that each individual has a preference for the method of information delivery or perception (audio, visual, or tactile, or kinesthetic) (Dunn and Griggs, 2000).

Sadoski and Paivio (2007) propose the Unified Theory of Reading, which states that reading can be broken down into three major aspects or subdivisions: decoding/recoding, comprehension, and response. Decoding involves converting printed language to a spoken language, whether it is understood or not and whether it is performed aloud or silently. Comprehension involves constructing meaningful interpretations of the received data (interpreting and inferring would fall into this category). Finally, the individual exhibits some form of response to the information (expressions, actions, etc.). The response phase may overlap the comprehension phase (Sadoski and Paivio, 2007).

Finally, Paivio’s Theory of Dual Coding, which was explained earlier (“Theoretical Framework”), proposes that information is received via two channels, verbal (written and
spoken words) and non-verbal (images). While only the Theory of Dual Coding is examined here, it should be noted that many different educational theories exist and are frequently used in educational research, none of which has gone unchallenged at some point in time.

**Teaching Methods in Nursing Education**

Professors in the traditional nursing classroom have relied heavily on textbooks to deliver the bulk of course content, with lecture functioning as a tool to highlight the most significant concepts and discussion to reinforce the acquisition of knowledge and promote independent critical thinking skills among students (Goodin and Stein, 2006). Power Points and video clips may accompany lectures (Carney and Levin, 2002), and in class assignments as well, but the bulk of learning for the nursing student is completed on the student’s own time outside of the classroom. Outside of the classroom, a nursing student’s most comprehensive source of course content is the textbook(s) from which the course content is taken. Because of the degree of independent learning required for nursing students, attention should be directed toward the quality of the materials they are using, including the effectiveness of the presentation of information.

**Efficacy of Teaching Methods**

Many educators and healthcare professionals today acknowledge the expanding nursing literature and the increased knowledge and skills necessary to perform competently in the healthcare environment (Bowles, 2006; Cherry and Jacob, 2008; Hoffman, 2008; Nobel et al, 2006). Forneris and Peden-McAlpine (2006) call for an evaluation of the efficacy of current and emerging teaching methods to ensure that today’s students are benefiting from the most effective and efficient teaching and learning methods available. In order to effectively evaluate and or validate these methods, each must be first isolated to the
greatest possible extent and implemented in a controlled setting where significant data may be obtained and the results of implementation examined with minimal interference from artifact.
CHAPTER III

METHODOLOGY

The Research Design

This study was a quasi-experimental study with a post test. The study participants were divided into an experimental group, which received illustrated handouts, and a control group, which received only the written information. The study was grounded on the hypothesis that students’ understanding of the cellular effects of crystal meth abuse would be greater when written information was combined with traditional two-dimensional illustrations than when written information alone was used to present the information. A demographic survey was used to determine the participant’s level of exposure to the subject material prior to completing the study. Post tests were used to evaluate each group’s comprehension of the information after reading the handouts. The results of the post tests were then studied to compare the results of the experimental group with those of the control group.

Instruments

Demographic Survey

A demographic survey was administered to each study participant at the initiation of the study. The survey consisted of six multiple-choice questions. Each participant marked his or her answers directly on the survey sheet and the answers were later tallied to generate the raw demographic data. The survey questions evaluated the participant’s exposure to METH education prior to participation in this study as well as the estimated extent of any previous exposure (see Appendix B).
Informational Handout

Research of current data on the effects of METH abuse on the cellular level was conducted. Retrieved data was collected, combined, and simplified to a Flesch-Kincaid Grade Level of 12.5 with a Reading Ease of 26.2, according to Microsoft Word 2003. This level was determined to be appropriate for the education and knowledge of nursing students in their sophomore and junior year of college. The handout was approximately two and a half pages long. Based on the data, the researcher created three illustrations in watercolor and various other two dimensional media to reflect specific concepts covered in the handout. The illustrations were printed on separate pages with a one-sentence descriptor of the content of the picture and were included in sequential order in the set of handouts distributed among the experimental group.

Post Test

The post test consisted of fifteen multiple-choice questions designed to elicit data reflecting the participants understanding of the content in the handout (Appendix E). For each question, four potential answers were provided. Each participant marked his or her answers on a separate scantron, which was later graded electronically to generate the raw post test data.

The first two questions explored the participant’s understanding of the physiologic goals of METH abusers and of the drug’s mechanism of action (the way in which the substance exerts its effect on the body). The subsequent questions were designed to evaluate the participant’s understanding the pathology of METH abuse on the cellular level. The very last question regarded the gross (involving the body as a whole) effects of METH use and
evaluated the participant’s comprehension of the clinical manifestations of chronic abuse as detailed in the handout.

**Sample**

The participant population was determined through convenience sampling from the undergraduate nursing students of Carson-Newman College. The inclusion criteria were as follows: the student must a) be a student of Carson-Newman College, b) be accepted into Carson-Newman’s BSN program, c) have completed all preliminary classes required by the nursing program, and d) be currently enrolled in NURS 203 (Pharmacology) and/or NURS 302 (Intro to Altered Health States), as these courses contained material relating to the topic chosen by this study. Additionally, it was determined that students at that point in the nursing program would have sufficient knowledge of prior courses (i.e. anatomy and physiology, chemistry, etc.) to allow them to understand the basic concepts behind the material.

The study participants were limited to those over eighteen (18) years of age and participants from both the traditional and the accelerated nursing program at Carson-Newman were included. Participants were excluded if they are enrolled in any graduate programs at Carson-Newman. The number of participants was determined by the number of students that volunteered to participate in the study, which was eleven (n=11). The participants were split into a control group and an experimental group, through distribution of randomly organized regular and illustrated handouts. There were five participants in the experimental group and six participants in the control group.

**Procedure**

The study was conducted within the facilities of Carson-Newman College’s School of Nursing and Behavioral Health. The collection of data from the participants took place on
two separate occasions, during day time hours and less than twenty-four hours apart. All necessary materials, including writing utensils were provided by the researcher. The participants arrived and were placed in a commonly used classroom that would have been reasonably familiar to them. The control and experimental groups were mixed together during each data collecting session. Each participant’s group identity was determined by random distribution of illustrated and non-illustrated handouts, which corresponded with the experimental and control groups, respectively. Before the distribution of the informational handouts, each participant signed a consent from, which was then returned to the proctor. The consent forms were labeled with sequential numbers in pen in the top right corner, and each participant was asked to write that number on each following piece of material he or she received.

Once the proctor received all of the consent forms, he or she distributed the demographic survey. The participants were allowed ten minutes to complete the survey, which consisted of six multiple choice questions, all of which were marked on the question sheet. When the surveys were returned, the proctor distributed the handouts. Each participant was allowed forty-five minutes to read the handout, which was slightly less than two and a half pages long. When the participants indicated that they had finished reading the handout, the handouts were retrieved and the participants were given the post test to complete. The post test consisted of fifteen questions and the participants were allowed forty-five minutes to complete it, marking their answers on a scantrons. Participants were allowed to mark on the handout and post test question sheet at liberty. The participants were free to go after completing the post tests and returning all materials to the proctor.
The signed consent forms were gathered by the proctor and placed in a manila envelope and sealed with the professor’s signature across the back flap. The demographic surveys and post test scantrons were sealed in the same way in one envelope, and the handouts and post test question sheets in another envelope. The materials were then delivered directly to the researcher, who processed the scantrons and transcribed the raw data from the scantrons and demographic surveys into Microsoft Excel. The data was then analyzed using SPSS Student Version 16.
CHAPTER IV

RESULTS

Demographic Data

Eighteen students originally indicated willingness to participate in this study. Of those, eleven students actually participated in this study (n=11). All participants were students enrolled in Carson-Newman College’s BSN program and were currently enrolled in either NURS 203 (Pharmacology) or NURS 302 (Intro to Altered Health States). Two participants (18%) indicated that they had not been exposed to METH education prior to participating in the study. The remaining nine participants (82%) indicated that they had been previously exposed. Of those that acknowledged previous exposure, three participants (33%) indicated that their prior exposure to METH education included information regarding the effects of METH abuse on the cellular level, and two participants (22%) were unsure if their prior exposure included this information. The remaining four participants (45%) indicated that they had not been exposed to this information in their experience with METH education prior to the study. Of the participants that indicated that they had been exposed to METH education on the cellular level, or were unsure, five participants (100%) selected “some” (out of “none,” “some,” and “a lot”) as the amount of exposure to education about the dangerous effects of METH abuse on the cellular level prior to participating in this study.

Data Retrieved From Participants

The mean score of all study participants on the demographic questions evaluating understanding of the general concepts of METH abuse prior to participation in the study was 72.5, with a range of 33 (1 out of 3 questions) to 100 (3 out of 3 questions).
The participants were divided into two groups: a control group and an experimental group. Post test mean for the control group was 77.66, with values ranging from 47 to 100. The mean for the experimental group was 78.4, with a range of 73-93 (Table 1).

**Data Analysis**

The difference between the experimental and control groups was analyzed with a t-test. Data was analyzed with a one-tailed t-test. The level of significance for this study was set at $p < 0.05$. The t-value was 0.759, which was statistically insignificant ($p = 0.467$). (Tables 1, 2, and 3).

**Summary of Findings**

The findings of this study were statistically insignificant. The study therefore could not confirm or refute the hypothesis that the use of illustrations would increase nursing students’ understanding of written material.
CHAPTER V

DISCUSSION

Demographic Data

The demographic data revealed that the majority of the study participants (82%) had been previously exposed to the material presented in the informational handout, although more than half of the participants (n=6) indicated that they had not been exposed to information or education on the effects of METH abuse on the cellular level. Information was not gathered regarding the gender of the study participants, but it may be observed that the clear majority of the nursing students enrolled in Carson-Newman’s BSN program is female. The demographic survey also did not include information about age, race, or previous education as these factors were not considered in this study.

Findings

While the results of the study were no statistically significant, some evidence emerged that suggests that further research may yield more definitive findings in favor of the hypothesis that illustrations increase nursing students’ comprehension of written material. The means for both groups were similar, but the mean of the experimental group was slightly higher than that of the control group (78.4 vs. 77.7). Additionally, the range for the control group was much wider and the bottom parameter much lower than that of the experimental group. This finding suggests that the use of illustrations may at least ensure a higher minimum level of understanding of written information.

Limitations of the Study

The study had multiple limitations. The small sample size (n=11) prevented the study from generating statistically significant data and prevented the study from being
generalizable to a larger population. During data collection not all materials were coded with numbers as originally intended. This prevented further analysis of subgroups and their corresponding results on the demographic data and subsequent post test. Not all variables that might affect the data were within the researcher’s control.

Additionally, the study did not account for the individual learning styles of each of the participants. This may have affected the study results as research indicates that the effectiveness of information transference is affected by the route of communication and the student’s learning styles (Dunn et al, 2009). Furthermore, the study did not differentiate between traditional first time undergraduate students, non-traditional students returning to school after a period of absence from institutional education, dual degree students, etc. Thus, the results could have been affected by any number of variables, such as generation, age, and previous non-nursing degrees. It should also be noted that the majority of the study participants (82%) had been previously exposed to METH education and this may have affected their performance in the study.

Finally, due to the small size of the group and the observation that the clear majority of students enrolled in the BSN program at Carson-Newman is female, this study’s sample lacked gender diversity. However, as nursing professionals (and consequently the population of student nurses) is predominately female (Meadus, 2000), this may actually be fairly representational of the general nursing student population.

**Implications of the Study**

Because the results of this study were not statistically significant, it remains to be determined whether illustrations improve understanding of written material among undergraduate nursing students. It may be noted, however, that a difference existed between
the range of the experimental group and the range of the control group, with the low of the experimental group significantly exceeding that of the control group (73 v. 47). Additionally, the mean of the experimental group slightly exceeded that of the control group (78.4 v. 77.7).

Future research should include a larger sample size ($n \geq 30$) that is representational of the general population (based on review of current research). For a more comprehensive view of the factors influencing students’ response to the study, demographic data should be expanded to include gender and educational background, along with any other variables that might affect the study. It may also benefit the researcher to consider the quality and characteristics of the handouts, illustrations, and post tests used in the study. Analysis of the different items in the post test and comparison of those items to the demographic data may be indicated.
References


http://0-find.galegroup.com.library.acaweb.org/itx/start.do?prodId=SPJ.SP00


Appendix A

The Role of Visual Representation in Nursing Student’s Understanding of Written Information
Carson-Newman College

Consent Form

Introduction
The purpose of this study is to examine the effects of visual illustrations in student’s understanding of written information.

Participant’s involvement in this study
You will be asked to read an informational handout about methamphetamine abuse. You will be asked to complete a brief, multiple choice test on the written material. Reading the material and taking the test should take approximately 30-45 minutes.

Risks
You understand that there are no risks or discomforts expected by participating in this research study.

Benefits
This study will contribute knowledge to the field of nursing research.

Confidentiality
Your name will not appear on the post test and will not be revealed in oral or written reports of the results of the study. Post tests and consent forms will be kept in a locked file cabinet in the Nursing Division at Carson-Newman College. The researcher and faculty advisors will have access to these files. At the completion of the study all posttests and consent forms will be destroyed.

CONTACT INFORMATION
If you have questions at any time about the study or the procedures, you may contact the appointed faculty member, Dr. Greg Casalenuovo at 865-471-3236 or the office of the Human Subjects Review Board at Carson-Newman College or Division or Nursing Research Committee at 865-471-3425 so that you can review the matter and identify any resources that may be available to you.

PARTICIPATION
Your participation is voluntary and you may choose not to participate or to withdraw from the study at any time without any consequences to your role as a student in the Carson-Newman nursing program, grade-wise or otherwise, or to your colleagues. You understand that there will be no monetary compensation if you choose to participate in this study.

CONSENT

I have read the above information. I have received a copy of this form. I agree to participate in this study.

Participant’s signature ___________________________ Date __________

Investigator’s signature ___________________________ Date __________
Appendix B

DEMOGRAPHIC SURVEY

Pre Test

1. Have you ever been exposed to information regarding the physical hazards of METH abuse?
   a) yes
   b) no
   c) unsure

2. Have you ever been exposed to information regarding the effects of METH abuse on the cellular level?
   a) yes
   b) no
   c) unsure

3. How much exposure have you previously had to education about the dangerous effects of METH abuse on the cellular level?
   a) none
   b) some
   c) a lot

4. For what is METH used?
   a) to achieve pain relief
   b) to create feelings of euphoria, increased alertness, and increased confidence
   c) to treat allergies and cold symptoms

5. How does METH affect the body?
   a) by causing the release of neurotransmitters from neurons in the brain
   b) by inhibiting the release of neurotransmitters from neurons in the brain
   c) by causing degeneration of blood vessels throughout the body

6. What effect does METH abuse have on the body?
   a) it eventually causes the nerves to become hypersensitive to stimuli (over-reactive)
   b) it results in symptoms of tremors, rigidity, and slowed movement similar to those caused by Parkinson’s and Huntington’s disease
   c) it leads to the development of meningitis, with subsequent brain damage
Appendix C

INFORMATIONAL HANDOUT

Understanding the Consequences of Meth Abuse on the Cellular Level

What is METH?
Methamphetamine (METH) is a stimulant drug similar to amphetamine. It is used to achieve “highs”, or feelings of intense pleasure and euphoria (Kish 2008).

Crystal meth (d-methamphetamine) is the most commonly abused form. This type of METH is usually smoked and is a more potent form of the drug (Buxton and Dove 2008). METH creates feelings of euphoria, a sense of well-being, and increased confidence. When people use METH they have increased alertness and lose their inhibitions. They also have a decreased need for food and sleep (Sheridan et al 2006).

METH is highly addicting and can cause psychoses, hallucinations, and paranoia. METH abuse causes long term damage to nerves in the central nervous system (Barr, et al 2006). METH abuse can cause cellular changes that have been compared to degenerative diseases such as Parkinson’s, Huntington’s, ALS (Lou Gehrig’s disease), and Alzheimer’s (Cadet et al; Kita et al; Imam et al).

How does METH work?
METH causes the release of neurotransmitters (dopamine, norepinephrine and serotonin) from nerve endings in specific regions of the brain. These neurotransmitters activate the cardiovascular and central nervous systems (Kish 2008). Activation of the sympathetic nervous system causes the behavioral effects mentioned above.

Norepinephrine increases heart rate and blood pressure. This is enough to cause death when METH is taken in high doses (Kish 2008).

METH-induced neurotoxicity
METH abuse is toxic to the nerves in the central nervous system. Damage can include depletion of neurotransmitters and loss of the corresponding receptors, and death of the nerve cell.

Depletion of neurotransmitters and loss of receptors
METH abuse depletes dopamine and serotonin levels in the brains of abusers (Quinton and Yamamoto 2006). Depletion of dopamine leads to symptoms of rigidity, tremors, and bradykinesia (slowed voluntary movement) that are characteristic of Parkinson’s disease (Mosby’s Dictionary 2006). Serotonin is a neurotransmitter that functions in mood, appetite, sexual activity, sleep, and memory, among other things. Depletion of serotonin levels can lead to anxiety, violent behavior, depression and impulsiveness (Martini 1989). Additionally, METH abuse causes a loss of dopamine and serotonin receptors doubling the impact of their absence (Cadet et al 2003).

Neuronal cell death
METH kills neurons through a process resembling apoptosis (programmed cell death) (Cadet et al 2003). Apoptosis is a natural process that the body uses to rid itself of unnecessary or defective cells. When induced by METH abuse, it leads to the loss of cells necessary for normal, even vital functioning (Marieb 2001). Some of these processes will be highlighted.

Oxidative stress. Free radicals are a byproduct of normal, aerobic cellular activity (Marieb 2001). When accumulated in excess they are damaging to cellular components (Marieb 2001). Free radicals derived from oxygen are called Reactive oxygen species (ROS). Reactive oxygen species (ROS) are highly damaging to nerve cells. They can cause DNA disruptions and mutations. They can also activate enzymatic cascades that can eventually lead to cell death (apoptosis) (Zigmond et al 1999).

Antioxidants protect the body’s cells from the damaging effects of free radicals. When a cell’s antioxidant defenses are inadequate or insufficient to completely detoxify free radicals damage occurs. Nerve terminals are damaged by lipid peroxides and oxidation of protein (Quinton and Yamamoto 2006).

METH causes increases of dopamine inside the cell, which can be oxidized to form ROS. The increase in ROS cause pores to form in the mitochondrial membranes (Siegel et al 2006). Cytochrome c is released into the cytoplasm of the nerve cell, where it binds to a protein called Apaf-1. This sets off a series enzymatic processes that ultimately can impair cellular repair processes, disrupt the cell’s cytoskeleton and change the cell’s nuclear and plasma membranes. The cell is marked for phagocytosis (Siegel et al 2006). Once it has been marked, macrophages and microglia engulf the dying cell.

Excitotoxicity. METH causes increases in extracellular glutamate. This leads to increases in Ca2+ levels inside the cell (Quinton & Yamamoto 2006). This activates various enzymes (kinases, lipases & proteases), which eventually results in the breakdown of cytoskeletal protein and the generation of free radicals (Quinton & Yamamoto 2006). In effect this stimulates the remaining events of apoptosis in the same manner as described above.

Mitochondrial dysfunction. Mitochondria are responsible for energy production inside cells (Mosby 2006). METH inhibits the electron transport chain (ETC), a phase of energy production that takes place inside the mitochondria. Inhibition of ETC enhances the toxic effects of METH (Quinton & Yamamoto 2006). Increases in intracellular levels of calcium (described above) also inhibit the ETC (Ibid). METH alters and disrupts mitochondrial functions, and their normal protective processes, therefore increasing its own damaging effects and contributing to the cell’s death.

End results

Oxidative stress, excitotoxicity, and mitochondrial dysfunction work together to create and perpetuate the toxic effects of METH in nerve cells (Quinton & Yamamoto 2006). Oxidative stress and excitotoxicity both increase the concentrations of free radicals (ROS & RNS) within the cell, and mitochondrial dysfunction eliminates some of the protective
measures against damage, allowing even more damage than it otherwise would have occurred. The damage inflicted by these processes leads to the death of the cell through a mechanism similar to apoptosis, or programmed cell death, which involves the activation of caspases and engulfment of the cell by phagocytes.

Conclusion
METH abusers suffer many consequences related to abuse of the drug. Emergency room visits involving METH increased by 54% between 1995 and 2002 (Quinton & Yamamoto 2006). Chronic use of METH can lead to psychotic and violent behaviors (Cadet et al 2003). Toxic doses produce agitation, anxiety, hallucinations, delirium, psychosis, cognitive and psychomotor impairment, seizures, and death (Cadet et al 2003). The long term depletion of dopamine has been associated with psychomotor slowing and memory impairments (Cadet et al 2003). The public needs to know that METH is not the key to permanent euphoria; it is a steep road to death.
References


Appendix D

INFORMATIONAL HANDOUT WITH ILLUSTRATIONS

Understanding the Consequences of Meth Abuse on the Cellular Level

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METH triggers the release of neurotransmitters from neurons in the brain, causing an increase in heart rate and blood pressure.
Neuronal cell death

METH kills neurons through a process resembling apoptosis (programmed cell death) (Cadet et al 2003). Apoptosis is a natural process that the body uses to rid itself of unnecessary or defective cells. When induced by METH abuse, it leads to the loss of cells necessary for normal, even vital functioning (Marieb 2001). Some of these processes will be highlighted.

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Figure 2. METH abuse leads to a loss of neurotransmitters (left side of brain). It also increases levels of free radicals which damage cellular DNA (left DNA strand).
Figure 3. A macrophage engulfs a neuron that has been marked for phagocytosis (blue markers).
**End results**

Oxidative stress, excitotoxicity, and mitochondrial dysfunction work together to create and perpetuate the toxic effects of METH in nerve cells (Quinton & Yamamoto 2006). Oxidative stress and excitotoxicity both increase the concentrations of free radicals (ROS & RNS) within the cell, and mitochondrial dysfunction eliminates some of the protective measures against damage, allowing even more damage than it otherwise would have occurred. The damage inflicted by these processes leads to the death of the cell through a mechanism similar to apoptosis, or programmed cell death, which involves the activation of caspases and engulfment of the cell by phagocytes.

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References


Appendix E

POST TEST

Posttest

1. METH is used to achieve:
   a) relief from pain associated with migraines, and chronic illness
   b) relief from insomnia (difficulty sleeping) and to improve appetite
   c) euphoria, decreased need for food and sleep, and increased alertness
   d) decreased anxiety and stress caused by anxiety disorders and high stress careers

2. METH works by:
   a) causing release of neurotransmitters dopamine, norepinephrine, and serotonin and activation of the sympathetic nervous system
   b) activating the parasympathetic nervous system, which increases digestion and slows heart rate and breathing
   c) directly stimulating the SA and AV nodes in the heart, which increases heart rate
   d) decreasing the neurotransmitters dopamine, epinephrine, and serotonin, resulting in lethargy and increased drowsiness

3. METH-induced neurotoxicity includes:
   a) depletion of neurotransmitters, loss of corresponding receptors, and cell death
   b) loss of muscle mass, lack of appetite, and brittle hair
   c) loss of nerve dendrites and inflammation of the nerve axon
   d) reverse flow of neurotransmitters at the axon terminal

4. Depletion of dopamine and serotonin can lead to:
   a) insomnia and increased REM sleep cycle
   b) increased drowsiness, euphoria, and increased urinary output
   c) loss of inhibition, increased sexual arousal and feelings of affection
   d) rigidity, tremors, anxiety, violent behavior, depression and impulsiveness

5. METH-induced cell death involves:
   a) thickening of the cell membrane along the axon and nerve terminal, preventing flow of chemical transmitters
   b) swelling of the cell and eventual bursting of the cell membrane
   c) marking the cell for destruction and engulfment by macrophages
   d) build up of lipids around the nerve terminal, preventing the flow of chemicals

6. Reactive oxygen species (ROS):
   a) cause DNA disruptions and enzymatic cascades that eventually lead to cell death
   b) are a beneficial by-product of cellular metabolism
   c) cause the cell to become hypersensitive to all stimuli
   d) create feelings of euphoria and well-being

7. Oxidative stress describes a condition in which:
   a) a cell’s antioxidant defenses are not enough to completely detoxify the free radicals that are generated
   b) the cell’s resources are stressed due to lack of oxygen
   c) increased oxygen levels disrupt normal cell function
   d) the cell’s supply of free radicals is depleted

8. Oxidative stress can occur when:
   a) there is a lack of oxygen in the cell
   b) there is an increase in the cell’s carbon dioxide levels
9. METH leads to oxidative stress by:
   a) decreasing the amount of oxygen available to the cell
   b) causing excessive increases of dopamine inside the cell
   c) causing an accumulation of carbon dioxide within the cell
   d) causing excessive increases of epinephrine inside the cell

10. Too much dopamine inside a cell is dangerous because:
    a) dopamine attacks the mitochondria of the cell
    b) dopamine can be oxidized to form reactive oxygen species
    c) dopamine bonds with cellular DNA
    d) the levels of dopamine may exceed the levels of serotonin

11. Excitotoxicity involves:
    a) the nerve cell becoming overly sensitive to all stimuli
    b) build up of neurotransmitters in the nerve, resulting in decreased reactivity
    c) increased electrical current in the cell membrane
    d) increased extracellular glutamate

12. The activation of glutamate receptors leads to:
    a) feelings of euphoria and sexual arousal
    b) feelings of depression and suicidal thoughts
    c) decreased levels of serotonin
    d) an increase in calcium inside the cell, which eventually results in the breakdown of cytoskeletal protein and generation of free radicals

13. Mitochondrial dysfunction is important in METH-induced neurotoxicity because:
    a) the mitochondria produce ATP for the cell
    b) the mitochondria are responsible for DNA synthesis
    c) the mitochondrial membrane disintegrates, releasing the mitochondrial contents
    d) METH inhibits the electron transport chain, which helps protect the cell from the damaging effects of METH

14. Oxidative stress and excitotoxicity both:
    a) result in increased free radicals inside the neuron
    b) involve increased electrical current throughout the neuron
    c) result in the loss of energy and heat from the neuron
    d) stimulate necrosis and leads to development of MS (multiple sclerosis)

15. Toxic doses of METH produce:
    a) euphoria, decreased appetite and need for sleep, increased confidence
    b) agitation, anxiety, hallucinations, delirium, and death
    c) loss of energy, fatigue, weight gain and depression
    d) relatively little effect
Appendix F

CARSON-NEWMAN COLLEGE
SCHOOL OF NURSING AND BEHAVIORAL HEALTH

REQUEST FOR REVIEW OF PROJECT
INvolving Human Subjects

I. IDENTIFICATION OF PROJECT

Principal investigator

Name: Mary Analeigh Kwee
Telephone: (706) 673-5047
Address: 142 Stonecrest Dr.
Rocky Face, GA 30740
E-mail address: makwee@cn.edu

A. Co-principal investigator(s): NA

B. Chair of the Thesis Committee and Committee Members (if applicable):
   Chair: Hester Daves
   Committee Members: Greg Casalenuovo
                       Gary Crotty
                       Sharon McAnear

C. Department/unit of committee chair: Business Division

D. Project identification: Research Project

E. Title of project: The Role of Visual Representation in Nursing Student’s Understanding of Written Information

F. Start date: Upon IRB approval

G. Estimated completion date: April, 2008

H. External funding (if any): None

II. TYPE OF REVIEW REQUESTED: Short review (minimal risk project)

III. DESCRIPTION AND SOURCE OF RESEARCH PARTICIPANTS

A. Human subjects (check all that apply)
   ___Inpatients      ___Volunteers      ___Pregnant Women
   ___Outpatients     ___Fetuses         ___Mentally Incompetent
   ___Minors         ___Prisoners       ___Elderly Population

B. Compensation to Human Subjects: None
C. Type of Project/Procedure to be used (please check the most applicable):
1. ____ Medical-Therapeutic (evaluation of drugs, treatment protocol, surgical procedure, etc)
2. ____ Medical-Non-Therapeutic (physiological studies, laboratory analysis of blood or body substance)
3. ____ Investigation drug (drug study protocol)
4. ____ Radioactive materials
   Name: __________________
   Subcommittee on radioactive materials approval date: __________
5. ____ Psychological-Manipulative (response to stressful stimuli, hypnosis, etc.)
6. _√_ Psychological-Non-Manipulative (evaluation of subject response to educational material, attitude, survey, etc.)
7. ____ Study involving confidential material without human participation (chart review, etc.)
8. ____ Other (please specify): __________________

D. Source of subjects/participants: Students enrolled in the Nursing Program at Carson-Newman College

E. Number of estimated participants: ≥30

F. Relationship between researcher/participant: The researcher and study participants will remain mutually anonymous for the purpose of the study and for the duration of the study as much as possible

G. IV. METHODS AND PROCEDURES:

Introduction
In a world where science is carrying healthcare forward at an exponentially increasing rate, nursing students in programs across the United States are under immense pressure to absorb greater and greater amounts of information than they were in the past. Along with the advances in scientific research and technology, methods of teaching growing amounts of material to students must be evaluated for efficacy and possible areas of improvement to ensure optimal transmission, retention, and comprehension of material by the students.

This study will consider and evaluate the effectiveness of traditional, two-dimensional visual illustrations on comprehension of the neurotoxic effects of crystal meth abuse on the nerves. Two groups of students will be given a set of written information on the effects of crystal meth abuse on nerves. A control group will receive the information only in text format. The experimental group will receive the text with illustrations. Data will then be gathered from both groups through a post test containing 10-15 questions on the topic material.

In effect, this study will evaluate the visual transmission of information to students through accurate and aesthetic original illustrations. It will have the added benefit of promoting awareness of crystal meth abuse, which is a growing societal concern.
Design
This study will be a quasi-experimental study with a pre-study demographic survey and post test. The study is grounded on the hypothesis that the student’s understanding of the neurological effects of crystal meth abuse will be greater when written information is combined with aesthetic two-dimensional illustrations than when written information alone is used to present the information. A pre-study survey will used to determine the participant’s level of knowledge in the subject material prior to completing the study. Post tests will be used to compare students’ understanding of the selected information in the presence and absence of visual illustrations.

Setting
The study will be conducted within Carson-Newman College’s School of Nursing and Behavioral Health. The presentation of the materials and the administration of the post test will take place in nursing classrooms, supervised by faculty within the School of Nursing. The student participants will be members of a BSN program and progressing through courses in NURS 203 and pathophysiology, courses within which the selected material is applicable. These students are actively involved in all/many phases of learning, and are therefore appropriate subjects for this study.

Sample
The participant population is determined through convenience sampling from the student population (of the nursing program at) of Carson-Newman College. To be included in the study, the participant must a) be a student of Carson-Newman College, b) be accepted into Carson-Newman’s BSN program, c) have completed all preliminary classes required by the nursing program, and d) be currently enrolled in NURS 203 (Pharmacology) and/or NURS 302 (Intro to Altered Health States), as these courses contain material relating to the topic chosen by this study. A consent form will be distributed to these groups by the professors coordinating the two selected courses, along with a written or oral explanation of what the study entails. The study participants will be limited to those over eighteen (18) years of age and participants from both the traditional and the Accelerated nursing program at Carson-Newman will be included. Participants will be excluded if they are enrolled in any graduate programs at Carson-Newman. The number of participants will be determined by the available number of students that volunteer to participate in the study but the sample size will consist of at least 30 persons. The participants will be split up into two groups, a control group and an experimental group, through random assignment so that each participate has an equal chance of being placed in one group or the other.

Instruments
Initial Demographic Survey
A survey will be administered to each participant before the distribution of the handout to determine the knowledge base of each participant before being exposed to the information in the handout. The survey will consist of five or six questions about recent exposure to METH education and some questions regarding the effects of METH abuse. The demographic surveys will have numbers in the top right corners corresponding with numbers
similarly located on the post test so that in the event that a participant should withdraw, their
demographic survey may be removed from the study data.

Illustrations and Handout

Research on the neurological effects of crystal meth abuse will be gathered and
reviewed with the aid of appropriate professors within the nursing division. Information from
the larger body of materials will be selected and compiled into 2-3 page typed handout.
Based on the information presented in the handout, illustrations will be created by hand using
watercolor and ink. To create a second handout, the exact, unaltered written information
from the first handout will be combined with the illustrations. Microsoft Word will be used
to assess the reading level of the information prior to distribution to determine possible
obstacles that may hinder the results of the study and alterations will be made as necessary to
ensure reliable data return.

Post test

Data will be collected using a self-administered questionnaire under the supervision of
School of Nursing faculty. The tests will be distributed to all participants at the same time or
as close together as possible in a given time frame to reduce the occurrence of cross-
contamination or early exposure to the test material through word of mouth. A control group
of students will be given the original text on the effects crystal meth abuse (sans illustrations)
to read. The experimental group will be given the text with the illustrations. Forty-five (45)
minutes will be allowed for each the reading of the handout and the completion of the post
test. The time allowed for each activity will be uniform for both the control and experimental
groups. Instructors will distribute the post test (corresponding to the number on the
demographic survey) to the participant as each participant returns the handout. The
classroom environments will be considered to ensure as homogenous a test-taking
environment as possible (i.e. temperature, lighting, time of day).

Data analysis

Data will be analyzed using appropriate statistical tests.

Data analysis

V. SPECIFIC RISKS/PROTECTION MEASURES: No physical, mental, or emotional
harm is anticipated during any part of the study. Participants choosing to withdraw
from the study may do so by not completing the post test. All incomplete
demographic surveys and post tests will be excluded from the data analysis and the
withdrawal noted in the sample information. Participants will be informed that the
materials they provide to the study will be completely anonymous and that it will be
analyzed and possibly submitted for publication.

VI BENEFITS: This study will generate information about the usefulness of two-
dimensional illustrations in helping nursing students understand written information.
It will have the added benefit of promoting awareness of crystal meth abuse, a
growing societal concern.

VII METHODS FOR OBTAINING “INFORMED CONSENT” FROM
PARTICIPANTS: Participants will be given consent forms to sign and turn in before
being included in the study.
VIII RESPONSIBILITY OF THE PRINCIPAL/CO-PRINCIPAL

By compliance with the policies established by the Nursing Research Committee, the PI subscribes to the principles stated in “The Belmont Report” and standards of professional ethics in all research, development, and related activities involving human participants under the auspices of Carson-Newman College. The PI further agrees that:

1. Approval will be obtained from the Nursing Research Committee prior to instituting any change in this research project
2. Development of any unexpected risk will be immediately reported to the Nursing Research Committee
3. An annual review and progress report will be completed and submitted when requested by the Nursing Research Committee
4. Signed informed consent documents will be kept for the duration of the project and for at least three years thereafter at a location approved by the Nursing Research Committee
IX. SIGNATURES – must be on a separate page
When you submit this application for review please note that all signatures must be original. As your application moves through the review process, you should maintain two identical applications, both of which contain original signatures. As primary investigator, you should keep one copy and submit the other application with original signatures for review.

Use the following format to prepare your signature section (as needed, add signature lines for all investigators, faculty advisors, and department chair, and research committee chair).

**Principal Investigator** __________________________

(Name)

Signature__________________________________________

(Date)

**Co-principal investigator** _______________________

(Name)

Signature__________________________________________

(Date)
The Role of Visual Representation

X. DEPARTMENT REVIEW AND APPROVAL - Must be on a separate page

The Nursing Research Committee has reviewed and approved the application described above and recommends that this application be reviewed as:

(  ) Expedited Review - Category (ies): __________________________

OR (  ) Full Nursing Research Committee Review

Chair, NRC ________________________________
(Printed Name)

Signature _____________________________________ (Date)

Dean, School of Nursing and Behavioral Health

______________________________________________
(Printed Name)

Signature _____________________________________ (Date)

Application sent to Graduate Council for final approval on _____________
(Date)

Approved: Graduate Council

Signature _______________________________ (Date)
Table 1.

*Study Data*

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