THE EFFECTIVENESS OF VISUALIZATION AS A STRATEGY TO TEACH INTRAMUSCULAR INJECTION ADMINISTRATION TO NURSING STUDENTS

by

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Visualization is a technique researched extensively in a variety of disciplines for its effects on psychomotor skill learning. Although the results of such studies support the use of visualization as a teaching strategy, the effectiveness of using visualization in psychomotor skill learning in nursing education has rarely been investigated. Of the few nursing studies that have been done, the results were inconclusive.

The purpose of this study was to test the effectiveness of visualization as a strategy to teach second year undergraduate baccalaureate nursing students how to administer a medication by intramuscular (I.M.) injection. The use of visualization with video demonstration and physical practice was compared to using only video demonstration and physical practice to teach this group of students I.M. injection administration.

Stallings' (1982) Information Processing Model was used to conceptualize visualization in relation to psychomotor skill learning. An experimental, post test only design was used to test the effectiveness of using visualization as a teaching strategy. Data were gathered from a convenience sample of 37 nursing students learning to administer I.M. injections for the first time.

Two instruments were used in the data collection procedure. First, prior to learning I.M. injection administration in a scheduled laboratory, students were rated on their ability to produce mental images using The Betts' Questionnaire Upon Mental Imagery (QMI) Vividness of Imagery Scale (Sheehan, 1967). The scores from this test were used to rate participants as having either a high or low imaging ability. High and low imagers were equally divided between the treatment and control groups. At the end of the injections laboratory, all study participants had one of their I.M. injections video-taped. Upon completion of the injections laboratory sessions, the investigator viewed the video tapes and rated each participant's performance using The I.M. Injection Performance Appraisal (Klimek, 1994).
The data were analyzed by using the univariate factorial (2X2) analysis of variance (ANOVA). Analysis of the data revealed no significant effect of the visualization treatment on participants' performance scores. However, several methodological and conceptual problems within the study's design and in the utilization of Stallings' conceptual framework could be responsible for the lack of significant findings. The implications of the findings for nursing education, practice, and administration were discussed.
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CHAPTER ONE
INTRODUCTION

Nursing is a practice discipline. As such, it is essential that nursing graduates are competent and confident in their ability to perform a variety of psychomotor skills. To produce such graduates, nurse educators are challenged to identify and utilize effective and efficient strategies when teaching psychomotor skills.

Background to the Problem

Nursing education is challenged to prepare graduates adept in the cognitive, affective, and psychomotor learning domains (Reilly & Oermann, 1990). Although competency in each of these domains is essential for quality nursing practice, emphasis placed on psychomotor skill learning has declined over the last few decades (DeYoung, 1990).

Few studies have been conducted to investigate psychomotor skill learning (Bachman, 1990; Bell, 1991; Gomez & Gomez, 1984). For this reason, theorists disagree about how psychomotor skills are learned. It is generally agreed, however, that input, practice, and feedback are all necessary components in the learning process (DeYoung, 1990; Gentile, 1972; Gomez & Gomez, 1984; Oermann, 1988; Stallings, 1982). An understanding of psychomotor skill learning must be the basis upon which teaching strategies are chosen.

The effectiveness of any teaching strategy depends upon the student’s stage of learning. There is general agreement among theorists that students progress through sequential stages as they learn psychomotor skills (de Tornyay & Thompson, 1987; DeYoung, 1990). However, students vary in their rate, ability, and style for achieving each stage in the learning process. In order to meet the individual needs of all students, teachers must utilize a wide repertoire of teaching strategies.

With today’s changing health care and educational environments, choosing teaching strategies to meet student needs is difficult. Technology is increasing, health care delivery is
shifting from institutional to community settings, and financial resources are scarce. Spending in education and health care has become significantly restricted. Teachers are challenged to find alternative ways to teach psychomotor skills as they do not usually have the luxuries of unlimited laboratory time, clinical time, and all the practice space and equipment that previously existed (DeYoung, 1990). Ultimately, these changes and limitations have resulted in graduate nurses performing complex, intrusive, and painful psychomotor skills on clients in a variety of settings using whatever resources are available. To produce nurses capable of meeting the demands of today’s dynamic health care environment, the strategies used to teach nursing students must foster creativity and improvisation.

Nursing education has traditionally used demonstration followed by physical practice as primary strategies to teach psychomotor skills (Milde, 1988). Depending on a student’s stage and style for learning, these teaching methods may or may not be optimal. Additionally, demonstration and physical practice are expensive teaching strategies that often require a number of faculty to implement. Substantial amounts of money, time, space, and equipment are expended when these strategies are used exclusively.

Non-traditional teaching strategies for the psychomotor learning domain are slow to be understood, accepted, and utilized in nursing education. Mental imagery (also known as visualization, mental practice, or guided imagery) is a teaching strategy that, through repeated studies, has been associated with improved performance, reduced anxiety levels, and cost-effectiveness. Visualization is a mental representation of reality in the absence of actual stimuli. An example of visualization is the mental image suggested by the expression "prick of a pin" or "reaching for a high shelf" (Eaton & Evans, 1986, p. 193; Vines, 1988).

Individuals using visualization can do so from either an internal or external perspective. Internal imagery, sometimes called kinesthetic imagery, involves viewing oneself from an internal perspective actually seeing and feeling the sensations that might be expected while participating
in the actual situation. Alternately, external imagery involves picturing oneself from the perspective of an external observer (as in viewing a movie).

Visualization is a strategy successfully used in many disciplines for many reasons. In sports, visualization is used to help athletes "picture" themselves winning; in diet therapy, visualization is used to help people who are dieting "see" themselves at their goal weight, and in nursing practice, visualization is used for relaxation and pain management. Unfortunately, visualization has rarely been used as a strategy to teach psychomotor skills in nursing education (DeYoung, 1990).

Visualization has potential to be an effective teaching strategy for some nursing students learning psychomotor skills. Intramuscular (I.M.) injection administration is one of the initial; most important, complex, and anxiety provoking psychomotor skills for undergraduate nursing students to learn (Coxson & Gillin, 1988; Eaton & Evans, 1986). Intramuscular injection administration is not "just a nursing skill", but a symbolic act that marks a student's "rite of passage" from layperson to nurse (Gendron, 1981, p. 31). Accordingly, each student has different feelings associated with giving I.M. injections and ultimately, learns the skill in his/her own way, and at his/her own pace. Considering the benefits of visualization and the success that visualization has had as a teaching strategy in other disciplines, I.M. injection administration might be taught more effectively if visualization were used in conjunction with physical practice (DeYoung, 1990; Eaton & Evans, 1986). Incorporating mental practice with physical practice when teaching injections to nursing students might do the following: (a) increase the amount of time students spend practicing the skill; (b) develop students' kinesthetic memory and thereby enhance their skill acquisition and retention (Feltz & Landers, 1983); (c) provide students with a time-efficient, supplemental alternative to physical practice; (d) promote independent learning (Richardson & Wylie, 1984); and (e) promote intrinsic feedback and self-evaluation (DeYoung, 1990; Stallings, 1982).
Problem Statement and Research Question

Nursing education is challenged to choose and utilize a variety of effective and efficient teaching strategies that meet the needs of a variety of students. To choose teaching strategies that achieve these goals, teachers require an understanding of how psychomotor skills are learned. Students' stages of learning and learning styles must also be considered. Additionally, teaching strategies should be cost and time efficient.

Visualization is a strategy that has been used effectively to teach a variety of motor skills to athletes. This strategy, however, has not been researched extensively for its effectiveness in nursing education. At best, results from studies to date have been contradictory and inconclusive with questionable validity and generalizability. There is presently no research that examines the effectiveness of visualization as a teaching strategy for learning intramuscular injection administration in a laboratory setting. If visualization were used as a supplemental strategy to teach undergraduate baccalaureate nursing students how to administer intramuscular (I.M) injections, would student performance on I.M. injection administration improve?

Definition of terms

The following is a list of terms and their definitions as used in this study:

1. Intramuscular injection administration: The act of preparing a medication and aseptically forcing the liquid into the body by means of a syringe into a simulated ventrogluteal intramuscular injection site (Urdang, 1983).

2. Laboratory setting: A safe, artificial setting where learners are encouraged to interact with and manipulate their environments utilizing appropriate resources with facilitation and guidance from nursing faculty.

3. Teaching strategy: Any approach employed to help students achieve educational objectives (deTornyay & Thompson, 1987). In this study, visualization, as a supplement to video demonstration and physical practice, was the teaching strategy to be tested. The educational
objective that was to be achieved by students was an understanding and ability to apply concepts and principles related to I.M. injection administration.

4. Undergraduate baccalaureate nursing students: Students in the second year of a four year undergraduate baccalaureate nursing program learning to administer injections for the first time.

5. Visualization: The mental representation of the process of preparing and administering an injected medication into a simulated client.

**Purpose**

The purpose of this study was to compare the effectiveness of using visualization with video demonstration and physical practice with using only video demonstration and physical practice as a strategy to teach second year undergraduate baccalaureate nursing students how to prepare and administer a medication by intramuscular injection into a simulated ventrogluteal injection site.

**Assumptions**

In this study, the following assumptions were made:

1. The use of teaching strategies facilitates students learning to prepare and administer I.M. injections.

2. Visualization is a strategy that can be used for teaching purposes.

3. Some students can produce mental images better than other students.

4. Students vary in their ability and/or desire to utilize mental imaging during learning.

5. Visualization is a strategy that can be matched or mismatched with students' preferred learning style.

6. The traditional teaching strategy of demonstration followed by physical practice is useful for nursing students in the initial stages of learning to administer injections.
Conceptualization and Significance of the Problem

Stallings' (1982) Information Processing Model serves as the framework from which to conceptualize visualization and its use as a teaching strategy in psychomotor skill learning. This model views motor learning as a closed-loop system of sensory input, central processing, motor output, and feedback (Figure 1). Sensory input refers to the recognition of stimuli from outside and within the body by sensory organs. What information "gets through" to an individual is dependent upon what occurs in central processing.

In central processing, information is perceived by the perceptual filter (PF), stored for a brief period in short term store (STS), attended to in the limited concentration channel (LCC), and hopefully, sent to memory where it will be called upon again to influence perception (in the PF), facilitate decision making (in the LCC), and organize movement (in motor control). Many factors can influence this feedback loop. Although any stimulus can activate sensory organs, an individual's perception of stimuli (PF) is influenced by the background of personal experiences stored in memory. People hear and see that which they have been conditioned to hear and see. Therefore, what is "taken in" by a learner seldom coincides with the information that a teacher provides (Stallings, 1982, p. 70).

Information that passes through the PF and enters the STS can be stored for only a brief time; unless it is used, it is lost. The amount of information that can be processed from the STS, at any given time, is governed by the LCC. Students can, therefore, attend to only one thing at a time. If students are asked to concentrate on more than their LCC permits, interference or overload can result. Stallings' analogy to this fact is the interference or "black out" in a television set that can be caused by an electrical storm (p. 71). Thus, teachers must consider not only the amount of information a learner is asked to handle but also the time between the presentation of that information and its use.

Motor output (MO) is determined by the events in central processing and the degree of
Figure 1. Stallings' Information Processing Model. A basic information-processing model for the use of practitioners. From Motor learning from theory to practice (p.69) by L.M. Stallings, 1982, Toronto: C.V. Mosby Co.
motor control an individual possesses. Learners impose their own organization on incoming information during central processing, muscle cells receive and execute these "messages", and motor output results. Because each of these stages is unique to each individual, each learner will respond differently to the same instruction or performance situation.

Information regarding motor output is interpreted by Information Feedback (IF) to help an individual improve the proficiency of a performance. Information feedback is critical to learning and can be accomplished either consciously or unconsciously, internally or externally. Either way, it is this part of the information processing system upon which teachers can intervene to improve learner performance.

Visualization is an example of a conscious, internal information feedback system (Figure 2). As a "rehearsal loop", visualization sustains information in the STS by repeatedly passing information through the Limited Concentration Channel (LCC) back to STS by way of the Perceptual Filter (PF) (Stallings, 1982, p. 78). This information feedback mechanism created during visualization maintains information in STS for a longer period of time which, it is believed, facilitates transfer of information into long term memory (Gentile, 1972; Stallings, 1982). If this is true, the benefits of using visualization as a strategy to teach injection administration clearly exemplify the significance of this study for nursing practice. Some of the benefits of using visualization as a teaching strategy would include:

1. Learning injection administration would be expedited as mental practice requires less time than does physical practice.

2. Performance of injection administration would improve as visualization is an individual process with inherent feedback loops for improving performance.

3. Cost, energy, and space efficiency would improve because no special facilities, equipment, or people are required to implement the strategy (Maring, 1990). No supplies would be wasted when performance errors were made and remedied, mentally.
Figure 2. Stallings' Rehearsal Loop. Information (*dotted lines*) passed from short-term store (STS) to limited concentration channel (LCC) back to STS by way of the perceptual filter (PF). From *Motor learning from theory to practice* (p. 78) by L.M. Stallings, 1982, Toronto: C.V. Mosby Co.
4. Students would rely more on intrinsic feedback; the most important type of feedback for learning (DeYoung, 1990). Students would identify optional approaches to problems, make choices about these options, arrive at creative solutions, and experience a successful skill "performance" before executing the task in reality (Ferguson, 1992; Richardson, Wilson, Sheehy, & Young, 1984).

5. The portability of visualization makes it easy to apply in any setting with any psychomotor skill.

Summary

To teach psychomotor skills to nursing students, teachers must utilize teaching strategies that are both effective and efficient. Research to date on psychomotor skill teaching and learning is sparse. Therefore, the most effective strategies for teaching the complex nursing skill of I.M. injection administration has yet to be identified.

The effectiveness of visualization has been extensively supported in a number of disciplines. However, visualization as a teaching strategy has received minimal attention from the nursing research community. This study's aim is to investigate the effectiveness of this concept in relation to nursing students learning to administer I.M. injections.

This chapter discussed the background to this problem and explicitly presented the problem statement and research question. The definition of the terms that were used in this study were presented followed by the purpose of the study, the study's underlying assumptions, and how the study was conceptualized using Stallings’ (1982) Information Processing Model.
CHAPTER TWO
LITERATURE REVIEW

Overview

This chapter reviews theoretical and research based literature relevant to the use of visualization. Visualization is a strategy that has been used successfully in a variety of disciplines. When visualization is used as a strategy to teach psychomotor skills, students achieve varying degrees of competence. The effect of visualization as a teaching strategy depends on a student's stage of learning and the learning style a student utilizes.

The literature review is organized into four sections: (a) visualization, (b) psychomotor skill competence, (c) stages of psychomotor skill learning, and (d) learning style and psychomotor skill learning.

Visualization

A review of relevant literature reveals that visualization has been researched and applied extensively in teaching skill acquisition in physical education, sports psychology, educational psychology, and rehabilitation medicine. Richardson (1967a,b) conducted retrospective research in mental imagery and examined the association between the use of mental imagery and motor performance in athletes. This study found that skill acquisition was hastened and there was a significant association between the use of visualization and improved skill performance and retention. From their research with twenty-four swimmers, White, Ashton, and Lewis (1978) found that internal visualization was significantly related to improvement scores among those students who used mental practice as a learning strategy. Similarly, in a classic study done by Clark (1960) on basketball players doing one-handed foul shots, subjects reported growth in their ability to visualize their shooting technique, a progressive increase in their confidence, and a more acute sense of "instantly recognizing mistakes" before performing the shot (p.568). Clark concluded that visualization "sharpened (their) perceptual ability" (p.568).
Few studies have investigated the effectiveness of using visualization as a strategy to teach either injection administration or any other psychomotor skill to nursing students. Eaton (1984) and Speck (1990) studied visualization as a teaching strategy specifically with undergraduate nursing students learning to administer their first injections. In their respective studies of sixty and twenty-six subjects, they both found no relationship between the use of visualization and performance in students giving injections. However, Richardson et al. (1984) found that visualization not only improved nurses' psychomotor skill performance but bridged "the gap between classroom content and making and implementing a decision in the clinical area" (p.40). Contradictory research findings such as these suggest the need for nursing research that accounts for confounding factors.

A number of potentially confounding factors exist in much of the visualization research to date. Some studies neglect to account for the complexity of the task upon which the visualization technique is used. Wrisberg and Ragsdale (1979) examined mental practice effects following thirty practice trials on either a low cognitive task (stabilimeter) or a high cognitive task (Blocks test) using samples of both experienced and novice learners. Wrisberg and Ragsdale (1979) found that with greater experience on the stabilimeter, the percentage of transfer decreased from 18 per cent to zero per cent. These data support the idea that mental practice effects are typically not found on motor tasks having few cognitive elements. Instead, tasks high in symbolic or cognitive elements benefit the most from mental practice (Feltz & Landers, 1983). On the Blocks test, experienced subjects had greater transfer than novice subjects (50 per cent versus 28 per cent, respectively). These findings support the idea that for tasks high in symbolic or cognitive elements, mental practice will be most effective when subjects have had some prior practice with the skill (Feltz & Landers, 1983).

The timing and sequencing of physical and/or mental practice is an important factor to consider when conducting research on visualization. A classic study conducted in 1930 by Lorge
(cited in DeYoung, 1990) studied three groups of students trying to learn to draw a picture while looking only at mirror images of what they were drawing. The first group physically practiced twenty times with no rest periods (massed practice) while the other two groups rested, for lengths of time ranging from one minute to one day, between each practice trial (distributed practice). The time it took for each participant to complete the drawing was measured. The findings showed that distributed physical practice was consistently more effective than massed physical practice. Lorge's (1930) experiment found no effect of the varying length of rest periods. Upon further investigation into similar studies however, DeYoung (1990) concluded that "distributed physical practice is best, that practice must be long enough for the learner to make appreciable progress, and that rest periods must be short enough that forgetting does not present a problem" (p. 183).

Unlike physical practice, massed mental practice may actually be more effective than distributed mental practice. Felz and Landers (1983) state that "Extended mental practice of the relevant aspects of a task can develop a capacity for narrowed or focussed attention... (thereby) occupying the majority of an individual's attentional capacity so task irrelevant thoughts and images are prevented from disrupting the ongoing priming of muscles for action" (p. 50).

The perspective an imager takes when visualizing can influence the results of visualization research. In their exploratory study, Mahoney and Avener (1977) found that within a sample of elite gymnasts, the more successful athletes relied primarily on internal imaging while the less successful athletes depended more on external imagery. Similarly, Start and Richardson (1964) found that internal imagery but not external imagery was related to a greater success in gymnastic moves. However, Myers, Cooke, Cullian, and Liles' (1979) did not find any relationship between image perspective and skill level. Epstein (1980) found that the "propensity to use external imaging relates negatively to motor performance" (p. 218). Epstein (1980) speculated that external imagery has two downfalls. Firstly, external imagery may not provide the
imager with potentially useful kinesthetic cues, and instead may focus the imager's attention on irrelevant or distracting aspects of the skill. Secondly, external imagery may enable the imager to assume the role of a critical, evaluative observer which may potentiate self consciousness and nervousness ultimately detracting from the performance.

Visualization has been studied in a variety of disciplines. Although studies involving athletes have shown a hastened skill acquisition and an improvement in skill proficiency when visualization was used, findings in nursing research have been inconclusive and contradictory. Most of the visualization research to date has not adequately controlled for potentially confounding factors. Many studies have not considered the complexity of the task, the timing and sequencing of practice, nor the imager's perspective. Research that accounts for confounding factors such as these remains wanting. To enhance the validity and generalizability of visualization research, confounding variables must be controlled.

**Psychomotor Skill Competence**

To achieve mastery in psychomotor skills, students must feel competent performing the skill (Bell, 1991). Competence implies not only executing a skill effectively and efficiently but also feeling comfortable with the performance (Bell, 1991). High anxiety levels have been associated with a decreased sense of competence in nursing students learning psychomotor skills (Mogan & Thorne, 1985). Visualization can be a useful tool for reducing anxiety and ultimately, achieving competence (Richardson, et al., 1984).

Using The State-Trait Anxiety Inventory (STAI), Biodot Stress Dots, performance times, and performance scores as tools to measure anxiety levels, Speck (1990) identified a statistically significant association, \( F(1, 23) = 8.514, p = .0008 \) between nursing students who used guided imagery prior to performing their first injection and their level of anxiety. Coxson and Gillin (1988) and Bachman (1990) obtained similar, although less significant results when they studied the relationship between visualization and anxiety levels in nursing students. The results from
these studies support the use of visualization as an anxiety-reducing agent and ultimately, a tool to enhance student competence in the performance of psychomotor skills (Richardson & Wylie, 1984).

Practice, including reinforcement and feedback, is also required for psychomotor skill competence (Day, 1989; DeYoung, 1990; Stallings, 1982). Historically, physical practice has been considered the most effective, if not the only means to practice (Goldman, 1972; Kanten, 1985; Ryan & Simons, 1982). However, physical practice is not always possible because of the lack of proper practice equipment, settings, time, and/or supervision (Bachman, 1990). An effective, and in some studies preferred, alternative to physical practice is mental practice (Richardson, 1967a).

During mental practice, a motor problem is solved and a "new plan of action for a forthcoming movement" is cognitively devised by evaluating feedback from previous actions (Lee, Swanson, & Hall, 1991, p. 77; Stallings, 1982). Every individual has a different aptitude for producing mental representations. Thus, the effectiveness of using mental practice as an alternative to physical practice is dependent upon an individual's ability to produce mental images. Rawlings and Rawlings (1974) studied the effects of visual-imagery ability on the performance of a motor task following mental rehearsal. In this study, forty-seven female college students were given concentrated physical practice in rotary pursuit tracking on a Marietta rotor. The results indicate that visual imagery control is an essential ingredient in the effective mental rehearsal of a motor skill. Richardson (1969) similarly found that individuals with vivid controlled imaging ability out performed those with weak controlled and uncontrolled imaging on simple gymnastic skills. More recent research, however, suggests that both high and low imagers can benefit in some way by using visualization (DeYoung, 1990; Eaton & Evans, 1986; Felz & Landers, 1983). Studies have been done to explore whether a learner's ability to use and benefit from mental imagery is correlated with any other abilities. The results of such studies have
indicated a lack of relationship between visualization and intelligence, comprehension, abstract thinking, logical thinking, mental multiplication, mechanical reasoning, gender, and school marks (DeYoung, 1990). Regardless of one's ability to produce mental images, a combination of mental and physical practice is considered to be the most effective at achieving optimal skill acquisition, performance, and retention (Bachman, 1990; DeYoung, 1990; Maring, 1990).

Both anxiety and practice can influence a student's level of psychomotor skill competence. Studies have shown a positive association between visualization and reduced student anxiety. Similarly, other studies have suggested that visualization can produce positive results when it is used as a supplement to and, in rare cases, instead of physical practice. Because imaging and other abilities do not determine whether or not an individual will benefit from using visualization, the use of this technique is worth considering.

**Stages of Psychomotor Skill Learning**

In order to gain competence in psychomotor skill performance, students must repeat the information processing cycle (Stallings, 1982). As the information processing cycle is repeated, students advance through sequential stages of learning. These sequential stages are described in several different taxonomies using a variety of terminology. Most of these taxonomies describe learners progressing through increasing levels of performance (Reilly & Oermann, 1985). Benner (1984) used The Dreyfus Model of Skill Acquisition to develop a taxonomy which explains how learners progress through five stages of proficiency as they acquire and develop particular nursing skills. The five stages are novice, advanced beginner, competent, proficient, and expert. According to Benner (1984), first-year nursing students are described as being in the novice stage of skill development. At this stage, learners have no experience and depend solely on rules to guide actions. Learners are unable to determine which parts of a task are important, or when an exception to a rule should be considered (Day, 1989). At graduation, nurses are viewed as being in the advanced beginner stage of skill development (de Tornyay & Thompson, 1987). Advanced
beginners "demonstrate marginally acceptable performance and have "coped with enough real situations to note (or have them identified by a teacher) the recurrent meaningful situational components, called aspects" (Benner, 1982, p. 403). Advanced beginners require assistance to decide what is the most important thing to do in new or strange situations as they are still reliant upon rules. Benner (1984) believes that the advanced levels of expertise are developed after graduation as clinical experience enables nurses to incorporate their background of understanding into their performance (de Tornyay & Thompson, 1987).

The effects of mental practice can be seen in both the initial and later stages of learning. Most research, however, suggests that the effects of visualization are most effective when subjects have had some prior experience with the task (Felz & Landers, 1983). Corbin (1967) found that novice learners required at least 7.3 minutes of previous physical practice to produce large effect sizes from mental practice. Clark (1960) obtained similar results with athletes performing one-handed foul shots. Clark noted that "a certain amount of motor experience is necessary before mental practice will provide a maximal effect. Further research is indicated" (p. 566).

Although the effects of visualization can be seen in all stages of learning, prior experience with a task seems to be essential. The optimal amount of prior experience has yet to be determined. At the very least, visualization should be introduced after some degree of familiarity and physical practice with the skill has been established.

Learning Style and Psychomotor Skill Learning

The effectiveness of strategies used to teach psychomotor skills depends not only on the student's stage of learning but also on the student's learning style. In all stages of skill development, students vary in their individual style for learning. Learning style refers to the unique ways in which a person perceives, interacts, and responds to the various elements in a learning situation (Kolb & Wolffe, 1981; de Tornyay & Thompson, 1987). A student's preferred way of receiving and processing input from the learning environment is considered the student's
dominant learning style. Using teaching strategies reflective of the dominant learning style is usually considered the best way to produce the greatest learning achievement (de Tornyay & Thompson, 1987). The purpose of a university education in nursing however, is not only to learn subject matter and/or tasks but also to develop and broaden the students’ learning potential (Partridge, 1983). Therefore, regardless of a student’s learning style preference, utilizing a variety of learning modes will not only maximize learning but will teach the student how to learn (DeYoung, 1990; Laschinger & Boss, 1984). Partridge (1983) reiterates this notion when she stated the following:

The wisdom of matching a student’s preferred learning style with a congruent instructional mode seems obvious, the student will likely be more comfortable with the educational interaction and will probably learn more effectively and efficiently. However, it is not quite that simple. The fallacy is that if a student habitually utilizes only one learning style, he may be at a serious disadvantage when confronted with the necessity to utilize a different mode (p.247).

Teachers must use of a variety of teaching strategies in order to appeal to learners with different learning styles. Presenting similar information in several ways not only allows students to select learning experiences that are more appropriate to their own learning style but also gives students the opportunity to utilize components of learning styles, different from their own, to expand their learning style repertoire (Ferguson, 1992).

Summary

The literature has demonstrated that visualization has been effectively used to enhance motor performance, hasten skill acquisition, and facilitate skill development in many athletic contexts. Few studies in nursing have explored the use of visualization as a teaching strategy and of those that have, results have been contradictory. These contradicting results can generally be
attributed to the lack of control of confounding factors in the studies.

A sense of competence is vital for students learning complex, anxiety-provoking nursing skills. To achieve competence, students must execute psychomotor skills in a relatively smooth manner with some feeling of confidence and comfort during the performance. In order to feel confident and comfortable, students need to practice. Both physical and mental practice have successfully assisted in developing student competence with nursing skills. The effectiveness of mental practice, however, may be related to a student’s stage of learning and learning style.

Most research suggests that the effects of mental practice (visualization) can be seen in all stages of learning but that the effects are greatest when students have had previous physical practice with the skill. In all stages of learning, students vary in their unique learning style. Using teaching strategies reflective of a student’s dominant learning style is often thought to produce the greatest learning achievements. Considering the underlying philosophy of a university education however, using teaching strategies not reflective of one’s dominant learning style may actually broaden the student’s learning style repertoire thereby teaching the student how to learn in novel situations. Regardless of whether students incorporate visualization as part of their personal learning style, visualization is a strategy worth investigating for its use and effectiveness in nursing education.
CHAPTER THREE

METHOD

Overview

This chapter sets forth the research design, setting, sample, and instruments used for this study. A description of the ethical considerations and the procedures used for data collection is followed by a discussion of how the data were analyzed.

Research Design

An experimental, post test only design was used to test the effectiveness of visualization as a strategy to teach I.M. injection administration. Each participant had one of their I.M. injections video taped, viewed, and rated by the investigator. A statistical univariate Factorial Analysis of Variance (ANOVA), also known as univariate Multi-way ANOVA, was performed to determine the significance of the results. Data were collected by two means: first, by a self administered imaging ability questionnaire and second, by an investigator-rated I.M. injection performance appraisal.

Setting and Sample

The study was conducted in Vancouver, British Columbia, Canada in the nursing laboratory settings of The University of British Columbia School of Nursing (U.B.C.S.O.N.). During the injections laboratory, a total of 16 laboratory groups, each consisting of between seven and nine students were in the process of learning how to prepare and administer subcutaneous and intramuscular injections (For the purpose of this study, only the I.M. injection component of the laboratory is discussed.). Each injections laboratory group was scheduled for one two-hour session. All laboratory groups were attended by a faculty member who acted as a facilitator and resource person. Equipment and supplies related to injection administration were available in each laboratory room to facilitate practice. Seafoam sponges were used to simulate I.M. injection sites.
A convenience sample of 37 participants was obtained from a target population of 120 second year generic undergraduate baccalaureate nursing students in the nursing program. Students participating in the study were required to conform to the following selection criteria:

1. Students must not have previously learned or experienced the administration of any type of I.M. injection to a person, animal, or thing.

2. Students must be physically capable of performing an I.M. injection.

**Instrumentation**

For the purpose of this study, data were collected by two means. First, subjects were rated on their ability to produce mental images using The Betts' Questionnaire Upon Mental Imagery (QMI) Vividness of Imagery Scale (henceforth called, the "imagery scale" or "questionnaire"), originally developed by Betts (1909) and, later, modified by Sheehan (1967a) (Appendix A). Permission to use Sheehan's version of Betts' questionnaire was obtained from the Clinical Psychology Publishing Company (Appendix B). Scores on the imagery scale were used to classify participants as either high or low imagers in order to ensure an equal distribution of imaging ability between the treatment and control groups. The lowest possible score (indicative of a high imaging ability) was 35. The highest possible score (indicative of a low imaging ability) was 245. Actual scores on the questionnaire ranged from 54 to 158 with a median of 78. Subjects who scored 78 or below on the imaging questionnaire were labelled, "High imager" (H.I.) and subjects who scored 79 or above on the imaging questionnaire were labelled, "Low imager" (L.I.). High and low imagers were randomly divided into the treatment and control groups.

Randomization was performed by listing the subjects in ascending order according to their scores on the mental imaging questionnaire and then assigning every other subject to the treatment group. Remaining subjects were assigned to the control group. The result was four randomly assigned sub-groups: Treatment/H.I., Treatment/L.I., Control/H.I., and Control/L.I.
The second instrument used in this study was The I.M. Injection Performance Appraisal (Appendix C), developed by the researcher. Each participant had one I.M. injection video-taped and, later, viewed and rated by the investigator using the performance appraisal. The resulting performance scores acted as the dependent variable in the study to indicate the effectiveness of the treatment. The independent variables were (a) whether or not the participant received the treatment and (b) whether the participant was a high or low imager.

The Betts' QMI Vividness of Mental Imagery Scale

According to Richardson (1969) and Sheehan (1967a), Betts (1909) developed "the most important" (p.45) and "comprehensive test of imagery available" (p.386). Sheehan (1967a) believed, however that Betts' 150 item questionnaire was "prohibitively long" (p. 386). Instead, Sheehan developed a shortened form of Betts' questionnaire (Appendix A) which he hoped would predict a subject's capacity to image, in a variety of sensory modalities, as accurately as Betts' original questionnaire. Sheehan's version of Betts' questionnaire consists of 35 items; five items within each of seven sensory modalities including visual, auditory, cutaneous, kinaesthetic, gustatory, olfactory, and organic. On a seven-point Likert scale, participants rate the vividness of the mental image each item produces from "perfectly clear and vivid" to "no image present at all" (Sheehan, 1967a).

Sheehan (1967a) established reliability and validity on his shortened form of Betts' questionnaire. Sheehan's analysis of the revised questionnaire found that it "measures a general ability to image in a variety of sensory modalities" (p. 388). When 43 components of Betts' original questionnaire were extracted, one single component accounted for as much as 39% of the total variance of scores on the test. All 35 items on the revised scale loaded highly on the factor, with an average loading of .57. Sheehan established criterion-related validity by using an independent sample of 28 male and 32 female volunteer undergraduate Psychology students to cross-validate his findings. Sheehan found a high correlation (.92) between scores on
his shortened form and scores on the original form.

Sheehan (1967b) assessed the stability of his shortened version of Betts' questionnaire by doing a test-retest reliability check. This check produced a reliability coefficient of .78 after a time interval of seven months. This finding suggests that Sheehan's (1967a) tool has satisfactory reliability (Polit & Hungler, 1991).

The Intramuscular Injection Performance Appraisal

The video-taped performances of participants administering I.M. injections were viewed and rated by the investigator using The I.M. Injection Performance Appraisal, developed by the investigator (Appendix C). The I.M. Injection Performance Appraisal consisted of 35 performance criteria involved in administering I.M. injections. Each of the 35 criteria was rated on a scale from zero to three; zero indicating a poor performance and three indicating an excellent performance. Performance criteria were scored as follows: (a) if a criterion was met completely, it was scored as three, (b) if a criterion was met partially, it was scored as two, (c) if an error or omission was made while performing one criterion, it was scored as one, and (d) if a criterion was not met, it was scored as zero. To enhance the reliability of the scoring system in the tool, each rating was operationally defined as follows:

1. "Completely met" meant that the participant executed the performance criterion as stated, without exception.

2. "Partially met" meant that the participant executed the performance criterion to some extent although either (a) forgot to do one aspect of the criterion or (b) did one aspect of the criterion incorrectly. For example, criterion #3 indicates that the participant will "wash hands". There are essentially three aspects inherent in handwashing. These include: a) using warm water, b) applying soap and, c) creating friction between the hands. If one of these three handwashing aspects was omitted or forgotten, the participant received a performance score of two for having partially met the criterion. If the participant forgot more than one aspect of the criterion or
performed more than one aspect of the criterion incorrectly, it was considered "not met" unless it was recognized by the participant before the end of the performance.

3. "Recognized error/omission later" meant that the participant either (a) made an error while doing the performance criterion or (b) omitted the performance criterion, but recognized the error/omission before the end of the performance.

4. "Not met" meant that the participant did not execute the performance criterion as stated.

The 35 scores obtained for the performance criteria were added together to produce each subject's total "performance score". Each subject's performance score was later used as the dependent variable in statistical analyses.

Reliability and validity were established for the I.M. Injection Performance Appraisal. To establish content and face validity for this tool, a review of the literature was conducted, followed by an expert review by five nurse educators. The nurse educators chosen to review the tool had a variety of educational and clinical backgrounds. Four of the nurse educators had a Bachelor of Science in Nursing (B.S.N.) degree and one had a Master's in Nursing (M.N.) degree. Of the three B.S.N. prepared educators, one had almost completed the M.N. degree and the other had almost completed the Master's in Education (M.Ed.) degree. Two of the educators were chosen for their expertise in laboratory teaching and the remaining three educators were chosen for their extensive medical-surgical clinical backgrounds, including coronary and critical care.

Each nursing expert provided feedback regarding the content validity of the tool. Based on the feedback obtained, one performance criterion was deleted, four criteria were modified, and one criterion was added to complete the final version of the I.M. Injection Performance Appraisal.

The stability of the performance appraisal was evaluated by the investigator using a test-retest reliability check on five of the study participants. Six weeks after all of the injection
performances had been viewed and rated by the investigator, the investigator randomly chose one or two performances from each of the four video tapes used during the study to re-view and re-score. Using a statistical calculator to determine a reliability co-efficient, the first and second scores of each of the five subjects were compared. The reliability co-efficient established from this check was .98. This high reliability coefficient is indicative of a stable measure (Polit & Hungler, 1991). Inter-rater reliability for this tool was not addressed as the investigator was the only person rating the participants' performances.

Upon using the final version of the performance appraisal tool on the first subject, the investigator immediately became aware that the reliability criteria of objectivity and comprehensibility were in jeopardy. The criterion of objectivity indicates that there should be as little room as possible for disagreements between two or more independent researchers applying an instrument to measure the same phenomenon (Polit & Hungler, 1991). Although the performance appraisal was not being used by more than one researcher, objectivity was still an issue. The researcher identified a number of problematic performance criteria in the tool. These problems were explicitly documented and remedial rules were established so that all subjects in the study would be evaluated equally. The performance criteria found to be problematic and the rules instated to deal with these criteria were as follows:

1. During their performance, some subjects did not state what they were doing (although they were instructed to do so in the introduction they heard before being video-taped). Performance criteria #1 and #2 indicate that the student will (a) check the patient record with the prescribed medication and (b) check the patient record for allergies, respectively. An observer has no way of knowing whether or not these two criteria have been achieved unless a subject explicitly states what is being done. It was decided in advance, therefore, that a subject would receive full marks for performance criterion #1 only if (a) the medication vial was held beside the physician's orders sheet and a comparison between the medication and the physician's order...
appeared to be occurring or (b) it was stated that the medication was being checked with the physician's orders. The subject received full marks for performance criterion #2 only if (a) the subject directly pointed to the area at the top of the chart (where the allergies were identified) or (b) explicitly stated that allergies were being checked.

2. Performance criterion #15 states that the subject will remove air bubbles from the syringe without contaminating the needle. This criterion evaluates two behaviors instead of one; removing air bubbles and not contaminating the needle. Thus, if a subject performed one behavior correctly and the other behavior incorrectly, it was unclear whether full, part, or no marks should be allotted. It was decided that if the subject did part of the performance criterion correctly, a score of two would be given.

Other problems identified in the tool threatened the reliability/validity criterion of comprehensibility. Polit and Hungler (1991) state that "either the subject or the researcher should be able to comprehend the behaviors required to secure accurate and valid measures" (p. 382). Although the tool had theoretically "passed" expert critique, the use of it in actual circumstances showed that performance criteria #5, #12, and #17 appeared very similar and, therefore, were difficult to differentiate. At first glance these criteria appeared redundant. However, it was decided that there were subtle differences between the three criteria and that any deletion would be contraindicated. Instead, the meaning of each of these performance criteria were clarified as follows:

1. Performance criterion #5 stated that the subject will calculate the correct dosage. Similarly, performance criterion #12 states that the subject will draw up one milliliter of medication. It was assumed that if one milliliter of solution was drawn up, the dosage calculation had been done correctly. Therefore, whatever rating was given for criterion #5, the same rating would also be given for criterion #12. The exception to this rule occurred when a subject calculated (and stated) the correct dosage but withdrew an inaccurate amount of solution into the
syringe.

2. Similar to performance criteria #5 and #12, criterion #17 states that the subject will withdraw the correct amount of solution. This criterion was clarified to refer to the amount of solution remaining in the syringe after the air bubbles had been removed. Although some subjects calculated the correct dosage and withdrew one milliliter of medication from the vial, after the air was removed from the syringe, the correct volume of solution was no longer present in the syringe.

3. As stated earlier, performance criterion #15 states that the subject will remove air bubbles from the syringe without contaminating the needle. Performance criterion #16 similarly states that the subject will expel excess medication without contaminating the needle. Because of the overlap of expected performance within these two criteria, both criteria required clarification. Criterion #15 was clarified to mean that a subject would not "squirt" medication in the air nor "dribble" medication down the needle while removing air. Criterion #16 was clarified to mean that if the syringe was being turned horizontal over the sink to remove excess medication, the subject would not contaminate the needle by putting the needle inside the sink or by tapping the needle on the edge of the sink to remove the last drop of fluid.

By identifying problematic performance criteria, clarifying their meaning, and instating rules to govern the expectations of the evaluator using this tool, it was expected that The I.M. Injection Performance Appraisal had an enhanced reliability.

Ethical Considerations

Approval to conduct this project was obtained from The University of British Columbia Behavioral Sciences Screening Committee For Research and Other Studies Involving Human Subjects (Appendix D). Permission to access students for participation was obtained through information/approval letters written to the Director of the School of Nursing (Appendix E) and the Second Year Nursing Coordinator (Appendix F). Information letters were also written to the
Coordinator of the Learning Resource Centre (Appendix G) and the second year nursing faculty (Appendix H).

One week before the I.M. Injection Laboratories were scheduled to begin, second year nursing students were informed of the purpose and procedures involved in the study. At the end of three regularly scheduled classes, students were given an information letter about the study (Appendix I), provided with a verbal description of events that would take place during the study, and given three dates, times, and locations where participant consent forms (Appendix J) and imagery questionnaires could be completed. If students chose not to participate in the study, they simply did not attend these sessions. Participants were informed both verbally and in writing on the consent form that they could withdraw from the study at any time without penalty to their position or status in the nursing program. Students were assured of confidentiality in that no personal data would be included on any forms and that participant’s U.B.C. student number would be used only to enable the researcher to track group members. Students were told that if they wished to view their video-taped injection that they could do so at any time after the lab that was convenient to both student and researcher. Students in the control group who wanted to receive the visualization treatment were told that this option would be made available at the completion of the study.

**Data Collection Procedures**

**Preparation for Students**

During the second week of September, 1994 (one week before the injections laboratories were scheduled to begin), students who consented to participate in the study were tested on their ability to produce mental images. To test participants’ imaging ability, subjects were asked to complete The Betts’ QMI Vividness of Imaging Scale (Sheehan, 1967a). Three sessions were arranged for participants to complete the questionnaire. Additional questionnaires were made available in the Learning Resource Centre for students who were unable to attend the scheduled
sessions. Based on their scores, study participants were labelled as either high imagers (H.I.) or low imagers (L.I.) and then, as equally as possible, randomly assigned to treatment and control groups. Ultimately, four groups were used for the purpose of this study. These included: Treatment-High Imagers, Treatment-Low Imagers, Control-High Imagers, Control-Low Imagers.

Before the injections laboratory, students were expected to engage in the following independent pre-laboratory learning activities: (a) familiarizing themselves with the variety of syringes and needles used for parenteral medication administration (each student was given a lab pack that contained a vial and syringe for practice purposes at home.); (b) viewing four parenteral medication videos; and (c) reading the text: Potter, P.A., and Perry, A.G. (1993). Fundamentals of nursing: Concepts, process, and practice. (3rd. ed.). (pp. 645-663, 668). Toronto: Mosby-Year Book, Inc.

During the Injections Laboratory, groups of approximately eight students each went to their assigned rooms as displayed on the school’s second year bulletin board. Faculty facilitators for each room were given the names of students who had agreed to participate in the study and who, therefore, would have one of their practice I.M. injections video-taped. Faculty facilitators were told which participants were assigned to the treatment group and which participants were assigned to the control group. Faculty were asked to tell subjects in the treatment groups (a) the room number in which the treatment was occurring and (b) not to speak aloud while in the treatment room. Subjects in both the treatment and control groups were asked by faculty (a) not to discuss whether they received the treatment with the investigator, and (b) to provide only their student number to the investigator before being video-taped [Henceforth, "the investigator" refers to either the researcher (who conducted all study activities in the nursing laboratories at the U.B.C.S.O.N) or the research assistant (who conducted all study activities at the alternative lab site) on behalf of the researcher].
Implementation

During the study, each injections laboratory session progressed as follows:

1. For the first 30 minutes of the laboratory, subjects familiarized themselves with the equipment and procedures used for I.M. injection administration. Each participant administered one I.M. injection into a seafoam sponge using the procedures and techniques they had seen in the pre-lab video demonstrations. All students in the laboratories were encouraged to engage in self-directed learning and to use faculty for facilitation purposes only.

2. After having physically practiced for 30 minutes, subjects in the treatment groups left their laboratory rooms and went to the room where the treatment was being administered. Subjects knocked three times before entering the treatment room to give the investigator notice of their arrival ensuring that the investigator did not see who was receiving the treatment. The investigator read the seven minute visualization treatment (Appendix K) from behind a curtain. Following the treatment, subjects were instructed to leave the treatment room immediately, without talking.

3. While subjects in the treatment group were receiving the visualization treatment, subjects in the control group continued to physically practice additional I.M. injection administration techniques and procedures as indicated in step one, above.

4. After the subjects in the treatment group returned to the original laboratory room, subjects in both groups re-engaged in scheduled learning activities until the last 30 minutes of the laboratory.

5. During the last 30 minutes of the laboratory, study participants alternately went to the designated laboratory room, to have a single practice I.M. injection video-taped by the investigator. Each participant entered the designated room, listened to the instructions on how the video-taping session would progress (Appendix L), stated their student number for the video-camera, and spent an average of six minutes performing an I.M. injection. Each subject was
video-taped checking the physician's orders, withdrawing the ordered medication, and administering the medication to a sponge. Participants were not expected to communicate with the sponge as though it were a client nor were they expected to landmark the injection site.

6. During the video-taping sessions, the investigator documented the time at which each subject entered and exited the room and took field notes on remarkable events that occurred while participants were being video-taped.

Two weeks after the video-taping sessions, the investigator began viewing and rating the subjects' I.M. administration performances. The investigator waited two weeks in order to bracket any information inadvertently obtained which might impact the researcher's objectivity and ultimately the results of the study.

**Data Analysis**

All statistical analyses for the data obtained during this study were accomplished by the computer software, Systat version 5.03, under the direction of a statistician in the Faculty of Education at the University of British Columbia. The univariate factorial (2x2) analysis of variance (ANOVA), a parametric test, was used to analyzed the two categorical variables and the single dependent variable involved in the study. The two categorical (independent) variables were (a) the visualization treatment (or lack thereof) and (b) the imaging ability of the subjects (either high or low). The dependent variable was the participants' performance scores giving an I.M. injection. The ANOVA was used to compute F-ratio statistics to analyze the main effects and the interaction effects of the independent variables on the dependent variable. That is, the F-ratios obtained from the ANOVA indicated whether there was a significant difference between the subgroup means and whether there was a joint or simultaneous effect of the two categorical variables. The four subgroups evaluated were: Treatment/High Imagers, Treatment/Low Imagers, Control/High Imagers, Control/Low Imagers. The significance level (p) was set at .05 to account for potential Type I (sampling) errors. For any main or interaction effects to be significant,
therefore, the F-ratio would need to be greater than would occur by chance due to sampling error 95 per cent of the time. According to Polit and Hungler (1991), with a significance level of .05, a power level of .80, and a small effect size, a sample size of approximately 50 participants should be used for the study. A convenience sample of 120 second year nursing students learning to administer their first injections was targeted in attempt to achieve this sample size. Unfortunately, the sample size of 37 obtained for this study was less than optimal. This smaller sample size ultimately increased the chance of making a sampling error (Polit & Hungler, 1991). For reasons to be discussed later, a sampling error was suspected after the results of the study were obtained. A univariate homogeneity of variance test, the Cochran's C Test, was then conducted using the Statistical Package for the Social Sciences (SPSS) to determine the presence or absence of cell homogeneity and ultimately determine whether the homogeneity assumption of ANOVA was violated.

Summary

This chapter presented the methodology for this study. A discussion of the experimental design used to test the effectiveness of visualization as a strategy to teach I.M. injection administration to nursing students was presented. The setting, sample, and instruments used in this study were addressed followed by an explanation of how ethical considerations were made. Lastly, a discussion of the methods used for data collection and analysis ensued.
CHAPTER FOUR
PRESENTATION AND DISCUSSION OF THE FINDINGS

Overview

The findings of this study are presented in three sections: (a) descriptive information on the sample of students used in the study, (b) results of the experiment, and (c) discussion about the accuracy, meaning, and importance of the results.

Descriptive Information

The sample consisted of first term, second year undergraduate nursing students in the baccalaureate nursing program at the U.B.C.S.O.N.. It is during the first term of second year in the nursing program that students learn to administer I.M. injections. This was, therefore, the time at which students were asked to participate in the study. Out of a total of 120 students in second year, only 40 students, all female, volunteered to participate in the study. From the original 40 volunteers who consented to participate, three had to be deleted for the following reasons:

1. The first student was deleted from the study because she did not complete an imaging ability questionnaire.

2. The second student was deleted because she did not have an I.M. injection videotaped.

3. The third student independently withdrew from the study when she realized that she would be video-taped performing an I.M. injection.

After the above three students were removed from the study, a total of 37 female participants remained. Eighteen students were in the experimental group and 19 students were in the control group. The experimental group consisted of eight students who were rated as high imagers (H.I.) and ten students who were low imagers (L.I.). The control group consisted of nine students who were H.I. and ten students who were L.I.. Demographic information on the participants was not obtained.
Results of the Experiment

Differences between the subgroup means and standard deviations were assessed. Table 1 presents a comparison of the number of cases (n), mean (M), and standard deviation (S.D.) in each subgroup. The highest possible score on the I.M. Injection Performance Appraisal was 105 and the lowest possible score was zero.

Table 1
Comparison of the Number of Cases (n), Means (M), and Standard Deviations (SD) Among the Four Subgroups

<table>
<thead>
<tr>
<th>Subgroups</th>
<th>n</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment High Imagers</td>
<td>8</td>
<td>76.63</td>
<td>21.44</td>
</tr>
<tr>
<td>Treatment Low Imagers</td>
<td>10</td>
<td>80.00</td>
<td>11.62</td>
</tr>
<tr>
<td>Control High Imagers</td>
<td>10</td>
<td>74.70</td>
<td>10.11</td>
</tr>
<tr>
<td>Control Low Imagers</td>
<td>9</td>
<td>68.67</td>
<td>11.57</td>
</tr>
</tbody>
</table>

Low imagers (L.I.) who received the visualization treatment scored higher (80.00) than L.I. who did not receive the visualization treatment (68.67). High imagers who received the visualization treatment scored slightly higher (76.63) than H.I. who did not receive the visualization treatment (74.70). An ANOVA, however, found these results to be insignificant.

Using a univariate factorial (2x2) analysis of variance (ANOVA), an F-ratio statistic was computed to analyze the main effects of (a) the visualization treatment (teaching method-A) and (b) subjects’ imaging abilities (imaging ability-B) on the performance scores. The interaction effect (A*B) of the independent variables on the dependent variable was assessed to discover whether there was a combined effect of the two variables. Table 2 presents the Anova Summary Table procured from the results of this study.
Table 2

Analysis of Variance (ANOVA) for I.M. Injection Performance Scores (Actual)

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>$E$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching Method (A)</td>
<td>1</td>
<td>2.07</td>
</tr>
<tr>
<td>Imaging Ability (B)</td>
<td>1</td>
<td>0.08</td>
</tr>
<tr>
<td>AxB</td>
<td>1</td>
<td>1.04</td>
</tr>
<tr>
<td>Error</td>
<td>33</td>
<td>(194.67)</td>
</tr>
</tbody>
</table>

Note: Values enclosed in parentheses represent mean square errors.

* $p < .05$

The probability level ("p-value" or "alpha level") of making a Type I (sampling) error for this study was set at 0.05 ($p < .05$). Because the F-ratio obtained from testing the effect of the visualization treatment on subjects' performance scores was 2.07, yielding a p-value of 0.16, this finding remains insignificant. That is, there was an insignificant main effect for the use of visualization as a teaching strategy upon performing I.M. injections ($F(1,33) = 2.07, p = 0.16$).

A similar, more dramatic result was obtained when participants' imaging abilities were evaluated for their effects on the performance scores. With a probability level of .78, the F-ratio of 0.08 was highly insignificant. This means that 78 per cent of the time one would be wrong in saying that imaging ability affects one's performance administering an I.M. injection.

No significant interaction effect was found between the use of visualization and the imaging ability of the subjects on their performance scores. The F-Ratio for the interaction was 1.04 yielding a p-value of 0.32.

Discussion

The non-significant findings derived from this study represent a lack of support for the
proposition that the use of visualization as a teaching strategy affects student performance administering I.M. injections. A number of methodological and conceptual problems with this study may account for this absence of significant results.

**Methodological Problems**

Two methodological limitations of this study were the sample size and the unanticipated circumstances surrounding the administration of the questionnaire.

Small samples are generally insufficiently powerful to provide a meaningful statistical test and therefore produce less accurate results than larger samples (Polit & Hungler, 1991). It has been shown that "many nursing studies have insufficient power (Polit & Sherman, 1990) and are therefore at high risk of committing a Type II error" (Polit & Hungler, 1991, p. 482). Type II errors occur when insignificant results are wrongly accepted; the results are actually significant.

A power analysis was done to assess whether a Type II error could have been committed. To calculate an approximate sample size for a study involving four sub-group means, an eta-squared estimate was made. The power level for this study was set at 0.80 and the alpha level was set at 0.05. In addition to these levels, a population effect size is also required to calculate an eta-squared. Because few nursing studies deal with visualization as a teaching strategy and of those that do, none had identified the population effect size; no estimates of eta-squared could be made on the basis of prior research. Cohen's (1977) conventional value of a "medium effect" resulting in the proportion of variance explained in ANOVA as .06, was used. The approximate sample size necessary to achieve a power of .80, an alpha level of .05, and an effect size of 0.06 as a function of estimated population values of eta-squared was calculated at 45 subjects per sub-group. This experiment was, unfortunately, undertaken with only eight to ten subjects per group. This small sample reduced the power of the statistical test used in this study, thereby significantly increasing the chance of making a Type II error. That is, there is an excellent chance that because of the small sample size, the results of this study have been found non-significant when,
in fact, they may actually be significant.

A small sample size not only increases the chance of making a Type II error, but also increases the chance of making a Type I error. Type I errors result from sampling fluctuations. The smaller the sample the greater chance of obtaining a deviant sample, unrepresentative of the target population (Polit & Hungler, 1991). Upon analyzing the sub-group means and standard deviations (S.D.), it was noted that the treatment/L.I., control/H.I. and control/L.I. sub-groups had similar S.D.'s of 11.62, 10.11, and 11.57, respectively (Table 1). Unlike these sub-groups, the treatment/H.I. group had an S.D. of 21.44. Because S.D. is an index of the variability of scores in a data set (Polit & Hungler, 1991), the large S.D. of the treatment/H.I. group is indicative of a heterogeneous group. A heterogeneous group increases sampling error (Polit & Hungler, 1991). The Cochran's C, a univariate homogeneity of variance test, was done to evaluate the homogeneity in the sample. The Cochran's C was .55332 with a p-value of approximately 0.024. This finding confirms the sample's lack of homogeneity between cells. The homogeneity assumption of ANOVA was violated (Arlin, 1992).

Upon establishing the lack of homogeneity in the sample, the performance scores of all subjects in the study were reassessed. It was noted that two of the eight students in the treatment/H.I. group had unusually low, outlying scores (henceforth called, "outliers"). These outliers were responsible for the high S.D. in the treatment/H.I. group. Upon investigating the reasons for these low performance scores, it was noted in the field notes obtained during the data collection that one of the outliers was a subject who had been interrupted during the videotaping of her I.M. injection. At the end of this subject's performance, the subject stated, "I felt very rushed after the interruption. I was very distracted". The interruption may account for the poor performance score obtained by this subject. There is no obvious reason to account for the second outlier in the treatment/H.I. group.

Interestingly, if the two outliers in the treatment/H.I. group were removed, the findings for
the study would have been dramatically different. Removing the two outliers in this group would produce a mean of 86.33 instead of the 76.63 mean that was actually obtained. This "revised" mean is more similar to what one would expect in a group of high imagers receiving a visualization treatment. The S.D. in this group would also change. Instead of the S.D. of 21.44 that was actually obtained, the revised S.D. of 13.82 would indicate a more homogeneous group by being more similar to the S.D.'s found in the other three sub-groups. Not surprisingly, the ANOVA Summary Table would also dramatically change with the removal of the two outliers from the treatment/H.I. group (see Table 3).

Table 3

Analysis of Variance (ANOVA) for L.M. Injection Performance Scores (Hypothetical)

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>( F )</th>
<th>Performance Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching Method (A)</td>
<td>1</td>
<td>8.220*</td>
<td></td>
</tr>
<tr>
<td>Imaging Ability (B)</td>
<td>1</td>
<td>2.390</td>
<td></td>
</tr>
<tr>
<td>A x B</td>
<td>1</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>31</td>
<td>(134.240)</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Values enclosed in parentheses represent mean square errors.

*\(^{p} \leq .01\)*

Although the two outlying performance scores in the treatment/H.I. group can not be removed from the study "post-hoc", it is interesting to note the difference in the results if the group had been more homogeneous. If the outliers were removed, the F-ratio (8.22) would indicate a significant difference (\( p = 0.007 \)) in the performance scores between those who received the visualization treatment and those who did not receive the treatment. This is a
significant change from the actual results ($F(1,33) = 2.07, p = 0.16$). The F-ratio relating subjects' imaging abilities to their performance scores would also improve ($2.39$), although not significantly ($p = 0.13$), but much more than what was shown in the actual results ($F(1,33) = 0.083, p = 0.78$). Lastly, by removing the outliers, the interaction effect is virtually zero ($F(1,31) = 0.001, p = 0.97$). The lack of an interaction means that any significant main effects would most likely be related to the variables being tested and not a result of an unseen interaction between the variables. The absence of an interaction also reduces the probability that a sampling error has occurred (Arlin, 1992).

Recent studies suggest a lack of relationship between visualization and other abilities such as intelligence and school marks (DeYoung, 1991). For this reason, demographic data were not collected for this study. If this information had been obtained, an analysis of covariance (ANCOVA) could have been done. The ANCOVA may have adjusted for the inequalities between the groups not covered by sampling and ultimately accounted for the insignificant findings.

In retrospect, three factors seem to have had a negative impact on the design of the sampling plan. It is believed that these factors may have contributed to the small sample size thereby reducing the generalizability of the results. Firstly, the target population of nursing students from which the convenience sample was obtained were just beginning their second year of nursing. The study was explained to this population on the second week of classes during a time when many announcements were being made to orientate the students to the school year. Participation in a study was most likely not a priority in comparison to the other information the students were trying to process at this time. Because the injections laboratories were scheduled for the third and fourth weeks of classes, there was no alternative time at which students could be informed about the study.

The second factor that could have dissuaded students from participating in this study is
that they had not yet experienced a second year laboratory. Students may have been inclined not to participate in a study until after laboratory learning experiences were more familiar.

The third factor believed to have reduced the sample size in this study involves the content learned in the injections laboratories. As described earlier, learning injection administration is one of the initial, most important, complex, and anxiety provoking psychomotor skills that nursing students must learn (Coxson & Gillin, 1988; Eaton & Evans, 1986). The thought of adding another dimension to this experience such as a study involving video-taping of an I.M. injection may have been too much for students to manage so early in the school year when performance anxiety was high.

The second methodological limitation of this study involves the procedural omissions that occurred during the administration of the imagery questionnaire. After using a variety of mental imagery questionnaires, Richardson (1969) concluded that Sheehan's (1967a) shortened version of Betts' (1909) questionnaire was undoubtedly the most significant. Richardson (1969) stipulated, however, that when using the questionnaire, subjects must understand the difference between a vivid memory and a vivid memory image. That is, some subjects may confuse the vividness of knowing with the vividness of picturing. This may cause a subject to obtain a high score on the imagery test and be very accurate in the reproduction of a visual pattern, yet the subject may still have weak imagery. Richardson (1969) concluded that "the only safe procedure is to administer the test to individuals or small groups of four or five subjects after close discussion to ensure that the nature of memory imagery is understood" (p. 48).

Contrary to Richardson's (1969) suggestions, no discussion about the nature of memory imagery was ever provided for subjects in this study. At any given time during the three, one-hour sessions, groups of between one and eight students completed the imaging questionnaire. Some students obtained the questionnaire from the Learning Resource Centre at an independently convenient time. If these students had questions about the imaging questionnaire,
they had no one to ask. The lack of attention to the procedures needed to effectively administer the imaging questionnaire may have resulted in low imagers being classified as high imagers. This possibility threatens the internal validity of this study.

In replication studies, internal validity would be enhanced if subjects were required to listen to a discussion of the difference between imaging and knowing I.M. injection administration. Following the discussion, subjects should be given an opportunity to ask questions about these concepts before completing the questionnaire. Subjects could attend a pre-arranged session to listen to these instructions, ask questions, and complete the questionnaire. However, considering the difficulty investigators sometimes have in recruiting volunteers for studies, ease of accessibility to the questionnaires would be critical. It may be more appealing to some students if the questionnaire could be completed at a personally convenient time. Therefore, in addition to pre-arranged sessions, questionnaires should also be available in a central location. A pre-recorded instruction tape could be used along with a "hot-line" telephone number for students to call with questions.

**Conceptual Problems**

Three theoretical shortcomings were identified in this study. These include: (a) the abundance of detailed information provided in the visualization treatment; (b) the lack of familiarity of injections students possessed before they were tested administering an I.M. injection; and (c) the lack of time provided for information processing after the administration of the visualization treatment. To explain the significance of these conceptual downfalls, the theoretical framework upon which this study was based must be re-examined.

Within Stallings' (1982) Information Processing Model, visualization can be conceptualized as a conscious, internal information feedback system (see Figure 2) referred to as a "rehearsal loop". As described in Chapter Two, during visualization, information is sustained in the short term store (STS) by repeatedly passing through the Limited Concentration Channel
(LCC) back to the STS by way of the Perceptual Filter (PF). Maintaining information in the STS for longer periods of time, as is done during visualization, facilitates transfer of information into Long Term Memory (LTM) where it can be used for Motor Control (MC) and Motor Output (MO). The proficiency of MO is improved by sensory input gained during Information Feedback (IF).

Upon considering how visualization was used in this study, it is evident that some of the inherent assumptions in Stallings' (1982) model were violated. The inherent assumptions within the STS, PF, and IF components were particularly affected. These components will be explicitly examined to explain the conceptual shortcomings of this study.

Stallings stipulates that the STS is limited by (a) the amount of information it can store (capacity) and (b) the length of time it can store information before the information is lost. Stallings claims that between four and seven "chunks" of information can be held in STS at any one time. These chunks of information begin to be forgotten in about two seconds. By 15 seconds almost all of the information in STS is gone.

In this study, information in the visualization treatment was not "chunked" into the large concepts involved in I.M. injection administration. Instead, the visualization treatment was comprised of many small pieces of information, in an effort to make it as vivid as possible. Felz and Landers (1983) state that "extended mental practice of relevant aspects of a task can develop a capacity for...focussed attention" (p. 50). This suggests that if the visualization treatment had contained less irrelevant information and focussed on four or five chunks of information, subjects may have (a) more readily perceived essential information in the PF, (b) retained this information in STS for greater lengths of time and (c) transferred this information into LTM to improve their performance during the video-taped I.M. injection.

The second conceptual oversight in this study can be explained by examining the PF. Among other functions, the role of the PF is to determine which elements of learning are important enough to be perceived and sent to STS and which are not. Stallings (1982) warns of
"the danger in mental rehearsal for beginners because they are more apt to transform or pool information while rehearsing" (p.77). Without enough background experience, learners cannot differentiate the essential from the non-essential aspects of a skill. Instead, learners "pool" new information with any background information of a skill in the STS creating, in essence, an "information stew" where all elements are treated with equal importance (p. 76).

Previous studies (Clark, 1960; Corbin, 1967; Felz & Landers, 1983) indicate that previous physical practice is needed for mental practice to be effective. Although subjects in the present study had 30 minutes of physical practice before receiving the treatment, this may not have been enough time for subjects to benefit from the visualization experience. The lack of background experience with I.M. injection administration may have contributed to essentially "overloading" the PF thereby inhibiting it from doing its job.

An example of how inherent assumptions within the PF were violated exists within the visualization treatment. Subjects were told that "Gravol comes in a plastic vial" and that "You check to ensure that your patient isn’t allergic to Gravol.". According to Benner (1984), an advanced beginner would consider checking allergies more significant than the type of container which housed the medication. To a beginning novice who lacks enough background understanding of the essential aspects of injection administration, however, these two pieces of information might be pooled. That is, in the learner's PF both pieces of information would be considered equally important and transferred into STS. This information would comprise two-sevenths of the total storage space available in the STS. As the visualization treatment continued, without the filtering process of the PF, a cycle whereby information is lost and replaced would exist. In retrospect, the visualization treatment should have been administered to subjects who had more than 30 minutes of experience with injection administration. More experienced subjects would have a better sense of what elements were and were not necessary to remember.

The third conceptual problem with this study can be explained by examination of
Information Feedback (IF) in Stallings’ (1982) model. Improvement in the proficiency of Motor Output (MO) is obtained during IF. The rehearsal loop that occurs during visualization is an example of IF. The potency of IF, ultimately a visualization treatment, is dependent upon "the teacher's ability to determine the intrinsic IF provided by the skill, to supplement this by the most effective means, and to call the learner's attention to both sources" (Stallings, 1982, p. 85).

Gentile (1972) suggests that IF is most effective when teachers provide enough time for learners to "profit and encode information...obtained during and after the movement" (Gentile, 1972, p. 19).

In this study, subjects lacked time to process the information and images used for IF. DeYoung (1990) and Felz and Landers (1983) agree that learners need time to attend to intrinsic feedback during and after a visualization experience. Unfortunately, the time allotted to the visualization treatment in this study was very restricted. The treatment was delivered as quickly as possible, lasting approximately seven minutes. Subjects were asked to return to their scheduled laboratory room immediately following the treatment. Ultimately, subjects were left with little time to process the information and images described in the treatment. From Stallings’ (1982) theoretical viewpoint, this lack of processing time meant that subjects did not benefit from intrinsic feedback, the most significant aspect of IF in the rehearsal loop. An improvement for using the visualization treatment would therefore include time following the treatment for students to (a) think about the information they processed, (b) review the significant images they produced, and (c) ask questions about any discrepancies they identified during IF.

Summary

This chapter presented and discussed the findings of the study. A description of the sample followed by a presentation of the results of the study were included. The results revealed no significant difference in the I.M. injection performance between students who were taught using the teaching strategies of visualization with video demonstration and physical practice
against students who were taught using only video demonstration and physical practice. A discussion about the accuracy, meaning, and importance of these results in relation to the study’s theoretical framework and other literature was presented. The conceptual and methodological shortcomings of the study were discussed.
CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

Summary

Nursing education is challenged to prepare graduates who are competent and confident in their ability to perform I.M. injection administration. Intramuscular injection administration is one of the most significant psychomotor skills that nursing students learn. Learning this skill is an essential step in a student's transition from layperson to nurse. Strategies used to teach I.M. injections must be chosen carefully.

Limited research has been done in the area of teaching and learning psychomotor skills in nursing. Because of this fact, many of the strategies used to teach psychomotor skills are based on tradition and not on research. A review of the literature suggests that a variety of strategies should be used to teach both injection administration and other skills to nursing students.

Teaching strategies are chosen after careful consideration of a number of factors. Teaching strategies are chosen in relation to students' stages and styles for learning. Depending on how students learn best and in what stage of the learning they occupy, teaching strategies have different degrees of effectiveness. Teaching strategies should foster creativity and improvisation in order to meet the changing demands in today's technological society. With significant budget restrictions affecting both health care and educational environments, a careful consideration of the cost efficiency and time effectiveness of teaching strategies is critical.

Visualization is a non-traditional, cost and time efficient teaching strategy that has been effectively used in a variety of disciplines for many reasons including improving athletic performance, reducing stress, and enhancing pain management. Although visualization has rarely been used as a strategy to teach psychomotor skills to nursing students, a review of the literature shows support for its use.

During visualization, a mental image of oneself performing a task is produced. When
engaging in visualization, the learner is mentally rehearsing the skill. According to Stallings’ (1982) Information Processing Model, rehearsal is an effective means of establishing information feedback to improve skill performance and proficiency. Stallings’ model is the conceptual framework from which the purpose for this study originated.

This study compared the effectiveness of using visualization with video demonstration and physical practice with using only video demonstration and physical practice as a strategy to teach second year undergraduate baccalaureate nursing students how to administer an I.M. injection. The setting for this study was two laboratory sites of a generic baccalaureate nursing program in Vancouver, British Columbia. Using an experimental, post-test only research design, a sample of 37 nursing students learning to administer I.M. injections was used to test the effectiveness of visualization as a teaching strategy.

Upon volunteering to participate in the study, students’ abilities to produce mental images were rated. Subjects completed The Betts’ QMI Vividness of Imaging Scale (Sheehan, 1967). Based on their scores, participants were labelled as either high or low imagers. High and low imagers were equally divided and randomly assigned to the treatment and control groups. During scheduled injections laboratories, participants in the treatment group heard a seven minute visualization scenario depicting the procedure for I.M. injection administration. Participants in the control group did not hear this scenario. During the last 30 minutes of the laboratory, all study participants were video-taped performing an I.M. injection. Two weeks after the experiment, the video-tapes were viewed by the investigator and the participants’ injection performances were rated using The I.M. Injection Performance Appraisal. Measures were taken to establish adequate reliability and validity with both of the instruments. Ethical principles for conducting research were followed.

The findings of this study were not significant. Using ANOVA, a lack of significant effect of the visualization treatment on participants’ performance scores was noted. Participants’
imaging abilities were evaluated for their effect on the performance scores only to find an even less significant F-ratio. An insignificant interaction effect between the use of visualization and the imaging ability of the subjects on the performance scores was also found.

The lack of significant findings of this study may be the result of several methodological and conceptual problems within the study's design and in the utilization of Stallings' conceptual framework. In terms of methodological limitations, two significant problems were evident. These included: (a) the small sample size and (b) mismanagement in the administration of the imaging questionnaire.

For reasons described in Chapter Four, a sample size of 37 subjects was used in this study. In order to establish the power level, significance level, and effect size desired, approximately 100 subjects should have comprised the sample. This small sample significantly reduced the power of the statistical tests used in the study. This reduced power may have produced less accurate results. Additionally, the small sample size may have contributed to a deviant sample. One of the four cells that were analyzed in the study contained two dramatically outlying scores. Because cell homogeneity is an inherent assumption of ANOVA, violation of this assumption undermines the accuracy of the results. After performing a univariate test for homogeneity, the Cochran's C test, this lack of cell homogeneity was confirmed.

The second methodological limitation of this study involved the administration of the imaging questionnaire. Information on how to complete the questionnaire was not provided to any of the participants. Some subjects completed the questionnaire independently and therefore had no one to whom they could ask questions. Because the use of the imaging questionnaire may have been interpreted differently by each participant, imaging scores may not be reflective of actual imaging ability. This fact threatens the internal validity of the study because the findings may not accurately reflect how well imaging ability relates to the performance of I.M. injection administration either with or without the visualization treatment.
In addition to the methodological flaws of the study, three conceptual oversights were also identified and discussed. Upon re-examining the inherent assumptions within Stallings' conceptual framework, the following conceptual errors were identified: (a) too much detail was provided in the visualization treatment, (b) students lacked adequate familiarity with injection administration before they were tested performing the skill, and (c) an inadequate amount of time was provided for information processing after the administration of the visualization treatment. Neglecting these points violates assumptions within Stallings' model and in doing so potentially contributes to this study's lack of significant findings.

Conclusions

The following conclusions have been drawn from the findings of this study:

1. Using visualization with video demonstration and physical practice is equally effective as using only video demonstration and physical practice as a strategy to teach nursing students I.M. injection administration.

2. There were several methodological and conceptual limitations within the study that may have accounted for the lack of significant differences in performance between the groups.

Limitations

The following were limitations to this study:

1. The extent of individual pre-laboratory preparation, including both mental and/or physical practice, could not be controlled and may have affected students' performances administering the I.M. injections.

2. Students learn what they rehearse, right or wrong (Stallings, 1982). If students practiced incorrectly either before the laboratory or during the visualization experience, therefore, performance scores may have been affected.

3. Students' motivation to learn I.M. injection administration may have affected their performance.
4. Different teachers were used to teach the injections laboratories. Variability in individual teachers' ability to facilitate learning can not be controlled and may have affected students' performance.

**Implications**

The nursing profession is divided into four interrelated domains including: nursing practice, nursing administration, nursing education, and nursing research. Although visualization has often been used for pain management purposes in nursing practice, this use of visualization was not the purpose of this study. The implications of this study, therefore, are not directly relevant to nursing practice. Similarly, the implications of this study cannot provide nursing administration with information on, nor a means to resolve the problems of organization, delivery, and evaluation of care. Instead, this study has implications that are directly relevant to nursing education and research.

**Nursing Education**

The findings of this study have major implications for nursing education. Traditionally, demonstration followed by physical practice has been the primary means of teaching psychomotor skills to nursing students. Because few studies have been conducted in the area of teaching and learning psychomotor skills, the exclusive use of these strategies is not supported by research. In fact, demonstration followed by physical practice has proven to be expensive in terms of the money, time, space, and number of teachers required. Additionally, the effectiveness of this teaching approach differs depending on the stage of learning and learning style a student possesses.

The findings of this study suggest that the use of visualization as a supplement to videotaped demonstration and physical practice is equally as effective as demonstration and physical practice, alone. Visualization is a non-traditional teaching strategy that requires few resources to implement. It is a "portable" strategy that students can use anytime and anywhere. Because
visualization can be used for both teaching and learning purposes, role-modelling its use may educate students on how visualization can be used for learning purposes in nursing education and teaching purposes in clinical practice. In essence, using visualization as a supplement to traditional teaching strategies may help students learn how to learn and teach.

No consensus has been reached as to how psychomotor skills are learned. It is generally agreed, however, that sensory input, practice, and feedback are all necessary components in skill development and acquisition. Visualization is mental practice and is believed to facilitate intrinsic feedback in learners. The use of visualization, therefore has two benefits. Firstly, it lengthens the time that learners spend practising psychomotor skills and secondly, it helps students "see" their mistakes to make plans for further development. Thus, visualization is a strategy that can be useful for the novice and expert, alike.

Although this study's findings suggest a lack of significant effect of using visualization as a supplemental teaching strategy, the benefits of using visualization that were not tested in this study support its use.

Nursing Research

A number of findings in this study have implications for nursing research. There were significant limitations in the design of this study. These included: (a) the small sample size, (b) the small sample size, (c) the fact that the sample originated from only one nursing program, and (d) the manner in which subjects completed the imaging questionnaire. These flaws in the research design limit the generalizability of the findings and threaten the study's internal validity. Restricting these design weaknesses in a replication of this study would enhance both the theoretical and empirical knowledge needed for teaching and learning psychomotor skills in nursing.

Replication studies should aim for an increased sample size. Increasing the sample size would reduce the chance of obtaining a deviant sample and increase the chance of homogeneity
within the sample. Statistical analyses would ultimately be more powerful resulting in more reliable findings. Enhancing the diversity of the sample would also decrease the chance of obtaining outlying scores from a deviant sample. The sample should be obtained from a variety of educational facilities including both university and college settings.

Conceptual frameworks are meant to serve as a "springboard" for identifying and exploring research problems (Polit & Hungler, 1991, p. 118). Inherent assumptions within the conceptual framework used in this study were violated. Without a thorough understanding and a proper usage of the conceptual framework, the study's findings are suspect. Future studies should aim to work within the bounds identified by the theoretical framework to enhance both the internal and external validity of the study.

Finally, there are a variety of opinions related to the amount of background experience required of subjects before visualization becomes beneficial as a teaching strategy. A study that identifies a minimal experience level required of learners before visualization is initiated would prove useful in researching and utilizing this teaching strategy. A study that might achieve this purpose would compare the effectiveness of visualization when used with nursing graduates and undergraduates in various stages of learning.

In conclusion, this study demonstrated that using visualization in conjunction with demonstration and physical practice is equally effective as using only demonstration and physical practice as a strategy to teach undergraduate nursing students I.M. injection administration. These results in no way suggest that using visualization is detrimental to learning. Because a review of the literature identifies many studies in various disciplines that support the use of visualization, this study should be replicated in order to obtain more reliable results.
References


Appendix A: Participant Questionnaire: The Betts' QMI Vividness of Imagery Scale
TITLE OF THE STUDY: THE EFFECTIVENESS OF USING VISUALIZATION AS A STRATEGY TO TEACH INTRAMUSCULAR INJECTION ADMINISTRATION TO NURSING STUDENTS

INVESTIGATOR: CONNIE KLIMEK, MASTERS STUDENT IN THE UNIVERSITY OF BRITISH COLUMBIA SCHOOL OF NURSING

FACULTY ADVISOR: RAY THOMPSON

The above study is being conducted as a thesis requirement for a Masters of Science in Nursing degree at The University of British Columbia. The purpose of the study is to test the effectiveness of using visualization as a strategy to teach intramuscular injection administration to nursing students. All participants in the study will follow the I.M. Injection Lab format as outlined in the N.230 and N.231 Winter session 1994-1995 Lab Manual. Before the I.M. Injection Lab, participants will be tested on their ability to produce mental images. High and low imagers will be equally divided into treatment and control groups. Treatment groups will receive a supplemental teaching strategy of visualization to augment the video-taped demonstration and physical practice that both the treatment and control groups are already receiving. Each student in the study will have one I.M. injection video-taped after having physically practiced for 30 minutes in the lab. The researcher will view and rate student performance seen in the video tapes. The visualization teaching strategy is in addition to teaching strategies already occurring in the lab and no scheduled learning experiences will be missed by participants in the study.

Approximately 20 to 30 minutes will be required for the purpose of this study. Most of this time is part of already scheduled laboratory time except for completing this questionnaire, which should take approximately 10 minutes.

Participation in this study is voluntary. Subjects may withdraw at any time from the study without prejudicing their education or class standing. The information obtained from the study will be kept confidential by the investigator. A code number will be assigned to participants’ names for the use with The Intramuscular Injection Performance Observation Sheet and The Betts QMI Vividness of Imagery Scale. Only the researcher will have access to participants’ scores on these tests.

There are no risks associated with this study. Potential benefits may include that visualization can be useful in (a) clinical practice for client teaching and (b) improving I.M. injection performance.

It is assumed that by completing this questionnaire, consent has been given by the participant.

PARTICIPANT STUDENT NUMBER:
The Betts' QMI Vividness of Imagery Scale

Instructions for doing the test:

The aim of this test is to determine the vividness of your imagery. The items of the test will bring certain images to your mind. You are to rate the vividness of each image by reference to the accompanying rating scale, which is shown at the bottom of the page. For example, if your image is 'vague and dim' you give it a rating of 5. Record your answer in the brackets provided after each item. Just write the appropriate number after each item. Before you turn to the items on the next page, familiarize yourself with the different categories on the rating scale. Throughout the test, refer to the rating scale when judging the vividness of each image. A copy of the rating scale will be printed on each page. Please do not turn to the next page until you have completed the items on the page you are doing, and do not turn back to check on other items you have done. Complete each page before moving on to the next page. Try to do each item separately independent of how you may have done other items.


Instructions for Using Betts' Questionnaire (continued):

The image aroused by an item of this test may be:

Perfectly clear and as vivid as the actual experience ........................................ Rating 1

Very clear and comparable in vividness to the actual experience ....................... Rating 2

Moderately clear and vivid ....................................................................................... Rating 3

Not clear or vivid, but recognizable ........................................................................ Rating 4

Vague and dim .......................................................................................................... Rating 5

So vague and dim as to be hardly discernible ......................................................... Rating 6

No image present at all, you only 'knowing' that you
are thinking about the object .................................................................................. Rating 7

An example of an item on the test would be one which asked you to consider an image
which comes to your mind's eye of a red apple. If your visual image was moderately clear and
vivid you would check the rating scale and mark '3' in the brackets as follows:

Item: 5. A red apple .................................................................................................. Rating: (3)

Now turn to the next page when you have understood these instructions and begin the test.
Think of some relative or friend whom you frequently see, considering carefully the picture that rises before your mind’s eye. Classify the images suggested by each of the following questions as indicated by the degrees of clearness and vividness specified on the Rating Scale.

Item: Rating:

1. The exact contour of face, head, shoulders and body .......................................................... ( )
2. Characteristic poses of head, attitudes of body, etc ............................................................... ( )
3. The precise carriage, length of step, etc. in walking ............................................................... ( )
4. The different colors worn in some familiar costume ............................................................... ( )

Think of seeing the following, considering carefully the picture which comes before your mind’s eye; and classify the image suggested by the following question as indicated by the degree of clearness and vividness specified on the Rating Scale.

5. The sun as it is sinking below the horizon ................................................................. ( )

Rating Scale:

The image aroused by an item of this test may be:

Perfectly clear and as vivid as the actual experience ............................................................ Rating 1
Very clear and comparable in vividness to the actual experience ........................................ Rating 2
Moderately clear and vivid ..................................................................................................... Rating 3
Not clear or vivid, but recognizable ...................................................................................... Rating 4
Vague and dim ...................................................................................................................... Rating 5
So vague and dim as to be hardly discernible ..................................................................... Rating 6
No image present at all, you only ‘knowing’ that you are thinking about the object ........ Rating 7
Think of each of the following sounds, considering carefully the image which comes to your
mind's ear, and classify the images suggested by each of the following questions as indicated by
the degrees of clearness and vividness specified on the Rating Scale.

Item:  
Rating:

6. The whistle of a locomotive ................................................................. ( )
7. The honk of an automobile ................................................................. ( )
8. The mewing of a cat ................................................................................ ( )
9. The sound of escaping steam ................................................................. ( )
10. The clapping of hands in applause .......................................................... ( )

Rating Scale:
The image aroused by an item of this test may be:

Perfectly clear and as vivid as the actual experience .................................... Rating 1
Very clear and comparable in vividness to the actual experience .................. Rating 2
Moderately clear and vivid ........................................................................... Rating 3
Not clear or vivid, but recognizable ............................................................. Rating 4
Vague and dim ............................................................................................... Rating 5
So vague and dim as to be hardly discernible ............................................. Rating 6
No image present at all, you only 'knowing' that you
    are thinking about the object .................................................................. Rating 7
Think of 'feeling' or touching each of the following, considering carefully the image which comes to your mind's touch, and classify the images suggested by each of the following questions as indicated by the degrees of clearness and vividness specified on the Rating Scale.

<table>
<thead>
<tr>
<th>Item:</th>
<th>Rating:</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Sand</td>
<td>(       )</td>
</tr>
<tr>
<td>12. Linen</td>
<td>(       )</td>
</tr>
<tr>
<td>13. Fur</td>
<td>(       )</td>
</tr>
<tr>
<td>14. The prick of a pin</td>
<td>(       )</td>
</tr>
<tr>
<td>15. The warmth of a tepid bath</td>
<td>(       )</td>
</tr>
</tbody>
</table>

**Rating Scale:**

The image aroused by an item of this test may be:

- Perfectly clear and as vivid as the actual experience ........................ Rating 1
- Very clear and comparable in vividness to the actual experience .......... Rating 2
- Moderately clear and vivid ......................................................... Rating 3
- Not clear or vivid, but recognizable .......................................... Rating 4
- Vague and dim .............................................................................. Rating 5
- So vague and dim as to be hardly discernible ................................. Rating 6
- No image present at all, you only 'knowing' that you are thinking about the object ......................................................... Rating 7
Think of performing each of the following acts, considering carefully the image which comes to your mind's arms, legs, lips, etc., and classify the images suggested as indicated by the degree of clearness and vividness specified on the Rating Scale.

Item: 

16. Running upstairs .................................................. ( )
17. Springing across a gutter ......................................... ( )
18. Drawing a circle on paper ......................................... ( )
19. Reaching up to a high shelf ..................................... ( )
20. Kicking something out of your way ............................. ( )

Rating Scale:

The image aroused by an item of this test may be:

Perfectly clear and as vivid as the actual experience ................ Rating 1
Very clear and comparable in vividness to the actual experience .. Rating 2
Moderately clear and vivid ............................................ Rating 3
Not clear or vivid, but recognizable .................................. Rating 4
Vague and dim ......................................................... Rating 5
So vague and dim as to be hardly discernible ...................... Rating 6
No image present at all, you only 'knowing' that you are thinking about the object ................................. Rating 7
Think of tasting each of the following considering carefully the image which comes to your mind’s mouth, and classify the images suggested by each of the following questions as indicated by the degrees of clearness and vividness specified on the Rating Scale.

Item: 

21. Salt ................................................................. ( )
22. Granulated (white) sugar ........................................ ( )
23. Oranges ............................................................ ( )
24. Jelly ................................................................. ( )
25. Your favorite soup .................................................. ( )

Rating Scale:

The image aroused by an item of this test may be:

Perfectly clear and as vivid as the actual experience ......................... Rating 1
Very clear and comparable in vividness to the actual experience ............ Rating 2
Moderately clear and vivid ................................................ Rating 3
Not clear or vivid, but recognizable ........................................ Rating 4
Vague and dim .................................................................. Rating 5
So vague and dim as to be hardly discernible ................................ Rating 6
No image present at all, you only ‘knowing’ that you are thinking about the object .................................................. Rating 7
Think of smelling each of the following considering carefully the image which comes to your mind's nose, and classify the images suggested by each of the following questions as indicated by the degrees of clearness and vividness specified on the Rating Scale.

<table>
<thead>
<tr>
<th>Item</th>
<th>Rating:</th>
</tr>
</thead>
<tbody>
<tr>
<td>26. An ill-ventilated room</td>
<td>( )</td>
</tr>
<tr>
<td>27. Cooking cabbage</td>
<td>( )</td>
</tr>
<tr>
<td>28. Roast beef</td>
<td>( )</td>
</tr>
<tr>
<td>29. Fresh paint</td>
<td>( )</td>
</tr>
<tr>
<td>30. New leather</td>
<td>( )</td>
</tr>
</tbody>
</table>

**Rating Scale:**

The image aroused by an item of this test may be:

- Perfectly clear and as vivid as the actual experience Rating 1
- Very clear and comparable in vividness to the actual experience Rating 2
- Moderately clear and vivid Rating 3
- Not clear or vivid, but recognizable Rating 4
- Vague and dim Rating 5
- So vague and dim as to be hardly discernible Rating 6
- No image present at all, you only 'knowing' that you are thinking about the object Rating 7
Think of each of the following sensations, considering carefully the image which comes before your mind, and classify the images suggested by each of the following questions as indicated by the degrees of clearness and vividness specified on the Rating Scale.

<table>
<thead>
<tr>
<th>Item</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>31. Fatigue</td>
<td>( )</td>
</tr>
<tr>
<td>32. Hunger</td>
<td>( )</td>
</tr>
<tr>
<td>33. A sore throat</td>
<td>( )</td>
</tr>
<tr>
<td>34. Drowsiness</td>
<td>( )</td>
</tr>
<tr>
<td>35. Repletion as from a very full meal</td>
<td>( )</td>
</tr>
</tbody>
</table>

**Rating Scale:**

The image aroused by an item of this test may be:

- Perfectly clear and as vivid as the actual experience  
  Rating 1
- Very clear and comparable in vividness to the actual experience  
  Rating 2
- Moderately clear and vivid  
  Rating 3
- Not clear or vivid, but recognizable  
  Rating 4
- Vague and dim  
  Rating 5
- So vague and dim as to be hardly discernible  
  Rating 6
- No image present at all, you only ‘knowing’ that you are thinking about the object  
  Rating 7
Appendix B: Copyright Permission to Reprint Betts' Imaging Questionnaire
September 15, 1994

Ms. Connie Klimek
5057 Chatham St.
Vancouver BC V5R 3Z2
CANADA

Dear Ms. Klimek,

You have our permission to use the article "A Shortened Form of Betts' Questionnaire Upon Mental Imagery" by Peter Winston Sheehan. 1967. *Journal of Clinical Psychology*, 23. pp 386-389.

We ask that you use the following credit line: Copyright 1967 by Clinical Psychology Publishing Co., Inc., Brandon, Vermont.

Sincerely,

[Signature]

Barbara A. Poljacik
Office Manager
Appendix C: I.M. Injection Performance Appraisal
Klimek (1994)

I.M. INJECTION PERFORMANCE APPRAISAL

SCORES FOR PERFORMANCE CRITERIA:

Completely met ................................................................. 3
Partially met ................................................................. 2
Recognized error/omission later ............................................. 1
Not met ................................................................. 0

DEFINITIONS FOR SCORES FOR PERFORMANCE CRITERIA:

1. "Completely met" means that the participant executed the performance criterion as stated without exception.

2. "Partially met" means that the participant executed the performance criterion to some extent although either (a) forgot to do one aspect of the criterion or (b) did one aspect of the criterion incorrectly. For example, criterion #3 indicates that the participant will "wash hands". There are essentially three aspects inherent to handwashing. These include: a) using warm water, b) applying soap and, c) creating friction between the hands. If one of these three handwashing aspects is omitted or forgotten, the participant will receive a performance score of 2 for having partially met the criterion. If the participant forgets more than one aspect of the criterion or performs more than one aspect of the criterion incorrectly, it is considered "not met" unless it is recognized by the participant before the end of the performance.

3. "Recognized error/omission later" means that the participant either (a) made an error while doing the performance criterion or (b) omitted the performance criterion, but recognized the error/omission before the end of the performance.

4. "Not met" means that the participant did not execute the performance criterion as stated.
<table>
<thead>
<tr>
<th>PERFORMANCE CRITERIA</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Checks patient record with prescribed medication</td>
<td></td>
</tr>
<tr>
<td>(ie. considers &quot;5-Rights&quot;: patient medication, dose, route, and time)</td>
<td></td>
</tr>
<tr>
<td>2. Checks patient record for allergies</td>
<td></td>
</tr>
<tr>
<td>3. Washes hands</td>
<td></td>
</tr>
<tr>
<td>4. Performs 3 medication checks</td>
<td></td>
</tr>
<tr>
<td>5. Calculates correct dosage</td>
<td></td>
</tr>
<tr>
<td>6. Tightens needle onto leur-lock tip of syringe</td>
<td></td>
</tr>
<tr>
<td>7. <em>Limbers up</em> plunger in syringe before use</td>
<td></td>
</tr>
<tr>
<td>8. Removes protective cap from needle</td>
<td></td>
</tr>
<tr>
<td>without contaminating needle</td>
<td></td>
</tr>
<tr>
<td>9. Firmly rubs top of vial with alcohol swab</td>
<td></td>
</tr>
<tr>
<td>10. Aspirates 1 cc of air</td>
<td></td>
</tr>
<tr>
<td>11. Injects air into vial</td>
<td></td>
</tr>
<tr>
<td>12. Draws up 1 cc of medication</td>
<td></td>
</tr>
<tr>
<td>13. Effectively manipulates syringe and vial while drawing up solution</td>
<td></td>
</tr>
<tr>
<td>14. Maintains asepsis while drawing up solution</td>
<td></td>
</tr>
<tr>
<td>15. Removes air bubbles from syringe without contaminating needle</td>
<td></td>
</tr>
<tr>
<td>16. Expels excess medication without contaminating needle</td>
<td></td>
</tr>
<tr>
<td>17. Confirms correct volume of solution</td>
<td></td>
</tr>
<tr>
<td>18. Takes alcohol swab, medication record, and syringe to patient’s bedside</td>
<td></td>
</tr>
<tr>
<td>19. Identifies patient</td>
<td></td>
</tr>
<tr>
<td>20. Checks for patient allergies</td>
<td></td>
</tr>
<tr>
<td>21. Loosens cap of needle without removing it</td>
<td></td>
</tr>
<tr>
<td>22. Opens alcohol swab before tauting patient’s skin for injection</td>
<td></td>
</tr>
<tr>
<td>23. Locates injection site</td>
<td></td>
</tr>
<tr>
<td>24. Swabs injection site aseptically</td>
<td></td>
</tr>
<tr>
<td>25. Tauts patient’s skin before injection</td>
<td></td>
</tr>
<tr>
<td>26. Injects needle at a 90° angle</td>
<td></td>
</tr>
<tr>
<td>27. Rapidly darts needle into injection site</td>
<td></td>
</tr>
<tr>
<td>28. Stabilizes syringe</td>
<td></td>
</tr>
<tr>
<td>29. Aspirates plunger on syringe</td>
<td></td>
</tr>
<tr>
<td>30. Checks for blood on aspiration</td>
<td></td>
</tr>
<tr>
<td>31. Injects medication slowly</td>
<td></td>
</tr>
<tr>
<td>32. Re-tauts skin before removing needle from injection site</td>
<td></td>
</tr>
<tr>
<td>33. Removes needle quickly</td>
<td></td>
</tr>
<tr>
<td>34. Massages site following injection</td>
<td></td>
</tr>
<tr>
<td>35. Disposes of needle and syringe in sharps box</td>
<td></td>
</tr>
</tbody>
</table>
Appendix D: The University of British Columbia Office of Research Services Behavioral Sciences Screening Committee for Research Involving Human Subjects Certificate of Approval
# Certificate of Approval

<table>
<thead>
<tr>
<th>PRINCIPAL INVESTIGATOR</th>
<th>DEPARTMENT</th>
<th>NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thompson, R.M.</td>
<td>School of Nursing</td>
<td>B94-0305</td>
</tr>
</tbody>
</table>

**INSTITUTION(S) WHERE RESEARCH WILL BE CARRIED OUT**

VH: UBC Site

**CO-INVESTIGATORS:**

Klimek, C., School of Nursing

**SPONSORING AGENCIES**

**TITLE:**

The effectiveness of using visualization as a strategy to teach intramuscular (I.M.) injection administration to nursing students

**APPROVAL DATE**

SEP 12 1994

**TERM (YEARS)**

3

**AMENDED:**


**MODIFICATION OF:**


**CERTIFICATION:**

The protocol describing the above-named project has been reviewed by the Committee and the experimental procedures were found to be acceptable on ethical grounds for research involving human subjects.

Dr. R. Corteen or  
Dr. I. Franks, Associate Chairs

Dr/R. D.Spratley  
Director, Research Services

This Certificate of Approval is valid for the above term provided there is no change in the experimental procedures.
Appendix E: Letter to the Director of the School of Nursing
LETTER TO THE DIRECTOR OF THE SCHOOL OF NURSING

September 7, 1994

TITLE OF THE STUDY: THE EFFECTIVENESS OF USING VISUALIZATION AS A STRATEGY TO TEACH INTRAMUSCULAR INJECTION ADMINISTRATION TO NURSING STUDENTS

INVESTIGATOR: CONNIE KLIMEK

FACULTY ADVISOR: RAY THOMPSON

Dear Dr. May:

As a part of my Master of Science in Nursing degree at The University of British Columbia, I am conducting research to test the effectiveness of using visualization as a strategy to teach intramuscular (I.M.) injection administration to nursing students.

A review of the literature suggests that there is limited research in the area of teaching and learning nursing skills. Traditionally, psychomotor skills in nursing have been taught using demonstration followed by physical practice. Visualization (also known as mental imagery) is a teaching strategy that has been used extensively and successfully in physical education, rehabilitation medicine, and educational psychology. I believe that nursing might also benefit from the use of visualization as a teaching strategy for psychomotor skill learning.

I am requesting permission to invite the 1994 second year students (and faculty, as applicable) to participate in this study. Permission from the second year faculty and coordinator will also be sought.

Permission from the U.B.C. Ethical Review Committee to execute this study is pending. If permission is granted, the proposed procedure that will occur during the study is as follows:

1. All participants in the study will follow the I.M. injection lab format as outlined in the N.230 and N.231 Winter session 1994-1995 Lab Manual.

2. One week before the I.M. injection laboratory, at the end of a regularly scheduled class, participants will complete a questionnaire that tests their ability to produce mental images. High and low imagers will be equally divided into treatment and control groups.

3. During the I.M. injection laboratory, treatment groups will receive a supplemental teaching strategy of visualization to augment the video-taped demonstration and physical practice that both the treatment and control groups are already receiving. The visualization teaching strategy is in addition to teaching strategies already occurring in the lab and no scheduled learning experiences will be missed by participants in the study. The three to five minute visualization scenario will be read aloud by faculty facilitators present in the lab rooms. Once the treatment is complete, each student in the study will have one I.M. injection video-taped. The video-taped injection should take approximately ten minutes of the student’s time.

4. After the I.M. injection laboratory, the researcher will view and rate student performances seen in the video tapes.
Approximately 20 to 30 minutes will be required for the purpose of this study. Most of this time is part of already scheduled laboratory time except for completing the questionnaire, which should take approximately 10 minutes.

All second year students will be invited to participate in the study. The students will be informed that participation in the study is voluntary and that they may withdraw from the study at any time. Student consents will be obtained and students will be advised that confidentiality will be maintained.

I look forward to hearing from you. Please contact me or Ray Thompson, my faculty advisor, for any questions or concerns.

Sincerely,

Connie Klimek, R.N., B.S.N.
Appendix F: Letter to the Second Year Coordinator
LETTER TO THE SECOND YEAR COORDINATOR

September 7, 1994

TITLE OF THE STUDY: THE EFFECTIVENESS OF USING VISUALIZATION AS A STRATEGY TO TEACH INTRAMUSCULAR INJECTION ADMINISTRATION TO NURSING STUDENTS

INVESTIGATOR: CONNIE KLIMEK

FACULTY ADVISOR: RAY THOMPSON

Dear Professor Dewis:

As a part of my Master of Science in Nursing degree at The University of British Columbia, I am conducting research to test the effectiveness of using visualization as a strategy to teach intramuscular (I.M.) injection administration to nursing students.

A review of the literature suggests that there is limited research in the area of teaching and learning nursing skills. Traditionally, psychomotor skills in nursing have been taught using demonstration followed by physical practice. Visualization (also known as mental imagery) is a teaching strategy that has been used extensively and successfully in physical education, rehabilitation medicine, and educational psychology. I believe that nursing might also benefit from the use of visualization as a teaching strategy for psychomotor skill learning.

I am requesting permission to invite the 1994 second year students (and faculty, as applicable) to participate in this study.

Permission from the U.B.C. Ethical Review Committee to execute this study is pending. If permission is granted, the proposed procedure for this study is as follows:

1. All participants in the study will follow the I.M. injection lab format as outlined in the N.230 and N.231 Winter session 1994-1995 Lab Manual.

2. Two weeks before the I.M. injection laboratory (the week of September 5, 1994), at the end of one or two core classes, students will be informed and consent will be obtained for participation in this study. I would require approximately ten minutes per class to accomplish this task. Second year faculty would also be informed about this study during this week. To inform faculty about the study and about their potential involvement, I would require approximately ten minutes of a second year team meeting.

3. One week before the I.M. injection laboratory (the week of September 12, 1994), at the end of a regularly scheduled class, participants will complete a questionnaire that tests their ability to produce mental images. Based on the results of this test, I would try to distribute high and low imagers equally between the treatment and control groups so to attain a sample representative of the population. Because students are choosing a lab time based on their individual needs, the distribution of high and low imagers probably won't be equal in both treatment and control groups. If absolutely necessary, therefore, I would have to ask individual students whether they would be willing to change lab groups to facilitate an even distribution of imaging ability.
4. During the I.M. injection laboratory, treatment groups will receive a **supplemental**
teaching strategy of visualization to augment the video-taped demonstration and physical practice
that both the treatment and control groups are already receiving. The visualization teaching
strategy is **in addition to** teaching strategies already occurring in the lab and no scheduled
learning experiences will be missed by participants in the study. Faculty facilitators in the
treatment groups would be required to read a three to five minute visualization scenario to the
participants.

5. Once the treatment is complete, each student in the study will have one I.M. injection
video-taped. The video-taped injection should take approximately ten minutes of the student's
time and will occur in room T170, when each student is ready.

6. After the I.M. injection laboratory, the researcher will view and rate student performances
seen in the video tapes.

Approximately 20 to 30 minutes will be required for the purpose of this study. Most of this time
is part of already scheduled laboratory time except for completing the questionnaire.

All second year students will be invited to participate in the study. The students will be informed
that participation in the study is voluntary and that they may withdraw from the study at any
time. Student consents will be obtained and students will be advised that confidentiality will be
maintained.

I look forward to hearing from you. Please contact me or Ray Thompson, my faculty advisor, for
any questions or concerns.

Sincerely,

Connie Klimek, R.N., B.S.N.
Appendix G: Letter to the Coordinator of the Learning Resource Centre
LETTER TO THE COORDINATOR OF THE LEARNING RESOURCE CENTRE

September 7, 1994

TITLE OF THE STUDY: THE EFFECTIVENESS OF USING VISUALIZATION AS A STRATEGY TO TEACH INTRAMUSCULAR INJECTION ADMINISTRATION TO NURSING STUDENTS

INVESTIGATOR: CONNIE KLIMEK

FACULTY ADVISOR: RAY THOMPSON

Dear Ms. Entwistle:

As a part of my Master of Science in Nursing degree at The University of British Columbia, I am conducting research to test the effectiveness of using visualization as a strategy to teach intramuscular (I.M.) injection administration to nursing students.

A review of the literature suggests that there is limited research in the area of teaching and learning nursing skills. Traditionally, psychomotor skills in nursing have been taught using demonstration followed by physical practice. Visualization (also known as mental imagery) is a teaching strategy that has been used extensively and successfully in physical education, rehabilitation medicine, and educational psychology. I believe that nursing might also benefit from the use of visualization as a teaching strategy for psychomotor skill learning.

I am requesting permission to invite the 1994 second year students (and faculty, as applicable) to participate in this study.

Permission from the U.B.C. Ethical Review Committee to execute this study is pending. If permission is granted, the proposed procedure for this study is as follows:

1. All participants in the study will follow the I.M. injection lab format as outlined in the N.230 and N.231 Winter session 1994-1995 Lab Manual.

2. Two weeks before the I.M. injection laboratory (the week of September 5, 1994), at the end of one or two core classes, students will be informed and consent will be obtained for participation in this study. I would require approximately ten minutes per class to accomplish this task. Second year faculty would also be informed about this study during this week. To inform faculty about the study and about their potential involvement, I would require approximately ten minutes of a second year team meeting.

3. One week before the I.M. injection laboratory (the week of September 12, 1994), at the end of a regularly scheduled class, participants will complete a questionnaire that tests their ability to produce mental images. Based on the results of this test, I would try to distribute high and low imagers equally between the treatment and control groups so to attain a sample representative of the population. Because students are choosing a lab time based on their individual needs, the distribution of high and low imagers probably won't be equal in both treatment and control groups. If absolutely necessary, therefore, I would have to ask individual students whether they would be willing to change lab groups to facilitate an even distribution of imaging ability.
4. During the I.M. injection laboratory, treatment groups will receive a supplemental teaching strategy of visualization to augment the video-taped demonstration and physical practice that both the treatment and control groups are already receiving. The visualization teaching strategy is in addition to teaching strategies already occurring in the lab and no scheduled learning experiences will be missed by participants in the study. Faculty facilitators in the treatment groups would be required to read a three to five minute visualization scenario to the participants.

5. Once the treatment is complete, each student in the study will have one I.M. injection video-taped. The video-taped injection should take approximately ten minutes of the student's time and will occur in room T170, when each student is ready.

6. After the I.M. injection laboratory, the researcher will view and rate student performances seen in the video tapes.

Approximately 20 to 30 minutes will be required for the purpose of this study. Most of this time is part of already scheduled laboratory time except for completing the questionnaire.

All second year students will be invited to participate in the study. The students will be informed that participation in the study is voluntary and that they may withdraw from the study at any time. Student consents will be obtained and students will be advised that confidentiality will be maintained.

I look forward to hearing from you. Please contact me or Ray Thompson, my faculty advisor, for any questions or concerns.

Sincerely,

Connie Klimek, R.N., B.S.N.
Appendix H: Letter to Second Year Faculty
LETTER TO SECOND YEAR FACULTY

September 7, 1994

TITLE OF THE STUDY: THE EFFECTIVENESS OF USING VISUALIZATION AS A STRATEGY TO TEACH INTRAMUSCULAR INJECTION ADMINISTRATION TO NURSING STUDENTS

INVESTIGATOR: CONNIE KLIMEK

FACULTY ADVISOR: RAY THOMPSON

Dear Faculty Member:

As a part of my Master of Science in Nursing degree at The University of British Columbia, I am conducting research to test the effectiveness of using visualization as a strategy to teach intramuscular (I.M.) injection administration to nursing students.

A review of the literature suggests that there is limited research in the area of teaching and learning nursing skills. Traditionally, psychomotor skills in nursing have been taught using demonstration followed by physical practice. Visualization (also known as mental imagery) is a teaching strategy that has been used extensively and successfully in physical education, rehabilitation medicine, and educational psychology. I believe that nursing might also benefit from the use of visualization as a teaching strategy for psychomotor skill learning.

The study will take place during the regularly scheduled injection administration laboratory on September 19, 20, 26, and 27, 1994, at both the V.H. and U.B.C. sites. All participants in the study will follow the I.M. injection lab format as outlined in the N.230 and N.231 Winter session 1994-1995 Lab Manual.

Your participation would be required only if you were facilitating students in a treatment group, in the study. The treatment group will require a three to five minute visualization scenario about administering an I.M. injection read to them. The control group and the students who chose not to participate in the study will not require this visualization intervention. Following the treatment, students in the treatment group will move to room T170 to have a subsequent injection video-taped. Students in the control group will also have an injection video-taped in room T170, after approximately thirty minutes of physical practice administering I.M. injections. All participants in the study will be video-taped preparing the medication and injecting the medication into a sponge, but not landmarking. The video-taping session should not take longer than ten minutes.

The amount of teacher time required for this study is approximately five minutes, if you are facilitating students in a treatment group. An additional ten minutes during a second year meeting will be required to have the study and how to administer the visualization scenario explained more thoroughly.

I would like to have ten minutes to address the entire second year nursing class to explain the study, at the beginning of at least two core nursing courses during the first week of the fall term.

All second year students will be invited to participate in the study. The students will be informed that participation in the study is voluntary and that they may withdraw from the study at any
time. Student consents will be obtained and students will be advised that confidentiality will be maintained.

I look forward to hearing from you. Please contact me or Ray Thompson, my faculty advisor, for any questions or concerns.

Sincerely,

Connie Klimek, R.N., B.S.N.
Appendix I: Letter to Second Year Students
LETTER TO SECOND YEAR STUDENTS

TITLE OF THE STUDY: THE EFFECTIVENESS OF USING VISUALIZATION AS A STRATEGY TO TEACH INTRAMUSCULAR INJECTION ADMINISTRATION TO NURSING STUDENTS

INVESTIGATOR: CONNIE KLIMEK

FACULTY ADVISOR: RAY THOMPSON

Dear Second Year Student:

My name is Connie Klimek. I am a Registered Nurse and a graduate student in the Master of Science in Nursing program at The University of British Columbia. For my Master's thesis, I am investigating the effectiveness of using visualization as a strategy to teach intramuscular (I.M.) injection administration to nursing students.

You are invited to participate in this study. There will be no risk or discomfort to you. For the purpose of this study, you will be required to complete a questionnaire to determine your ability to produce mental images. During the injection laboratory, several laboratory groups will receive a supplemental teaching strategy while learning how to administer I.M. injections. The supplemental teaching strategy is a three to five minute visualization scenario depicting the procedure for administering an I.M. injection. Because the visualization teaching strategy is in addition to teaching strategies already occurring in the lab, you will not miss any scheduled learning experiences if you chose to participate in the study. During the I.M. laboratory, you will be video-taped performing one I.M. injection. This video-tape will be viewed and rated, using an I.M. performance checklist, by the researcher. The video-tape will not be used for evaluation purposes by faculty. The total amount of time that would be required of you for the purposes of this study is between twenty and thirty minutes. With the exception of the ten minute questionnaire which will be completed at the end of a regularly scheduled class, the remaining time occurs during laboratory time.

Your participation in this study is entirely voluntary. You may withdraw from the study at any time without prejudicing your education or class standing. To ensure your identity on the imaging ability questionnaire and the I.M. performance checklist remains confidential, a code number will be assigned and your name will be known only to the investigator. Your name will not appear in any study findings or reports.

Because of the importance of this study, your time and cooperation will be greatly appreciated. In order that students do not know what groups they are in, you are asked not to discuss what you learn in the injection laboratory with your classmates. If you have any questions or concerns, please call me or my faculty advisor.

Thank you for your assistance.

Sincerely,

Connie Klimek, R.N., B.S.N.
Appendix J: Participant Consent Form
PARTICIPANT CONSENT FORM

TITLE OF THE STUDY: THE EFFECTIVENESS OF USING VISUALIZATION AS A STRATEGY TO TEACH INTRAMUSCULAR INJECTION ADMINISTRATION TO NURSING STUDENTS

INVESTIGATOR: CONNIE KLIMEK

FACULTY ADVISOR: RAY THOMPSON

This certifies that I agree to participate in the above study. I understand the purpose of the study is to test the effectiveness of using visualization as a strategy to teach intramuscular injection administration to nursing students. To achieve this purpose I understand that the following procedures will occur:

1. I will be tested on my ability to produce mental images.

2. I will be placed in a laboratory group which will either receive or not receive a visualization experience. I understand that the visualization teaching strategy is in addition to teaching strategies already occurring in the lab and that I will not miss out on any scheduled learning experiences.

3. I will have one of my injections video-taped and, later, rated solely by the investigator. No other faculty will have access to my performance score or my imaging ability score. I have had the study explained to me and I have had opportunity to contact either the investigator or faculty advisor for any questions or concerns that I have. I acknowledge receipt of a copy of this consent form.

I understand that my participation is voluntary and that I may withdraw at any time from the study without prejudicing my education or class standing. I understand that the information obtained will be kept confidential by the investigator and that a code number will be assigned to my name for the use with The Intramuscular Injection Performance Observation Sheet and The Betts QMI Vividness of Imagery Scale. I am aware that I will receive no money for my participation and that there are no risks involved to me. I understand that I may view my videotaped injection following the lab at a time mutually convenient to myself and the investigator and that I can find out the results from the study in the Research Unit at the U.B.C. School of Nursing.

I agree to spend up to approximately 30 minutes involving myself for the purpose of this study. I have received a copy of this consent form for my records.

SIGNATURE: ___________________ DATE: __________ PRINTED NAME: __________________
STUDENT NUMBER: __________
Appendix K: Visualization Treatment
Klimek (1994)

VISUALIZATION TREATMENT

TITLE OF THE STUDY: THE EFFECTIVENESS OF USING VISUALIZATION AS A STRATEGY TO TEACH INTRAMUSCULAR INJECTION ADMINISTRATION TO NURSING STUDENTS

INVESTIGATOR: CONNIE KLIMEK

FACULTY ADVISOR: RAY THOMPSON

General Instructions for the Investigator

The following is the "treatment" for use in the above experiment. Only participants in a treatment group will receive the following visualization experience. Students in control groups can request the visualization treatment upon completion of the study.

Dim the lights. Participants sit or lie in a comfortable position (lying on a fairly warm floor or bed is optimal). Students should not be touching each other. Faculty read the visualization scenario in a soft voice using a relaxing tone (not irritating). Silence is an active process and should be used appropriately. Time must be given to complete each image in the scenario. The best way to judge the amount of time needed is for the teacher to go through the imagery strategy as well. At the end of the visualization scenario, process the experience; check everyone to be sure there were no negative experiences.

Actual Visualization Scenario

As a participant in this study, you are going to experience a teaching strategy that's a little different than most teaching strategies you are familiar with. This strategy is called, "visualization". You are going to use visualization to apply the concepts you have learned about intramuscular injections.

Before we begin, I'd like you to relax. Close your eyes. Let your body sink into the bed. Take a deep breath through your nose. Exhale slowly through your mouth. Inhale another deep breath. Exhale slowly. Let the tension go. Breathe deeply, in and out. Feel your muscles relax with each breath. Keep your eyes shut.

I'd like you to imagine, as clearly as you can, the scenes I will describe to you. I'd like you to see in your mind's eye the things around you. Imagine the sounds you would hear, the aromas you would smell, and the feel of things you touch. If there are emotions that would arise from the situation, let yourself feel these emotions.

You are asked to prepare and administer an I.M. injection of Gravol. You check your patient's chart with the medication for the "5 Rights" (the right patient, medication, dose, route, and time). While in the chart, you flip to the section that tells you what medications your patient is allergic to. You check to ensure that your patient isn't allergic to Gravol. On your way to the medication room, you stop to wash your hands.

In the medication room, you find the Gravol sitting in a bin of stock medications. You do
your first medication check. The Gravol comes in a plastic vial with a grey rubber stopper on top. It's a clear liquid. The name, Gravol, is typed in black ink on the side of the vial. Below the name, the concentration 50mg/ml, is typed in bold, black print. Your patient needs 100mg. A quick medication calculation tells you that you will be drawing up 2 mls. of solution. (PAUSE).

Beside the bin of stock medications is a variety of syringes with needles already attached with a luer-lock tip. Because you are going to draw-up 2 mls. of Gravol, you want to use a 3cc or 5cc syringe. Finally, you find the syringe you want. Now, you have to choose whether you want to use the syringe with a 1" or 1 1/2" needle attached. You choose the 1 1/2", 22 gauge needle as you remember that this is the needle most commonly used with I.M. injections. (PAUSE). The syringe and needle come loosely wrapped in packaging that has clear plastic on one side and white paper with bold printing on the other side. The top of the wrapper has two pieces that aren't stuck together. You pull these two pieces of wrapper apart to free the sterile syringe and needle from the covering. You hold the plastic syringe in your hand and screw the needle onto the leur-lock tip of the syringe. You notice that the needle is very loosely attached to the syringe. You think to yourself that it's a good thing you tightened it. Feel the plastic warm to the temperature of your hand. You pull the plunger out and push it in a few times. Initially, the plunger sticks to the inside of the syringe. But after a few pulls and pushes, it "limbers" up and slides easily. You pull the cap covering the needle straight off. After the cap is off, you notice that the steel needle is very sharp. You see the bevel on the needle. You loosely replace the protective cap and place the syringe back on the tray.

The plastic vial of Gravol is sitting on the counter beside you. You do a second medication check, just to be sure. You remove an alcohol swab from its packaging and firmly rub the rubber stopper on the top of the vial. You wait for the alcohol on the stopper to dry. While waiting, you pick up your syringe and aspirate 2 mls. of air. The alcohol on the stopper has dried. So, you stick your needle through the center of it. You notice that the rubber stopper is quite thick and initially causes some resistance as you try to puncture it. Once pierced, your needle easily slips the rest of the way into the vial. With the needle in the vial, you turn both the syringe and vial upside down and hold them in your non-dominant hand. Between which two fingers are you holding the vial? (LONG PAUSE). How are you stabilizing the syringe? (PAUSE). You look at all the sterile zones on the needle, syringe, and vial and make sure that your hand isn't inadvertently touching anything. You aspirate the plunger on the syringe. Fluid and a large air bubble fill your syringe. You have to remove the air. So, you take the needle out of the vial and point its sharp bevel towards the ceiling. That large air bubble is clinging to the side of the syringe. You easily jar it loose with a couple firm taps on the side of the syringe. The bubble rushes upwards toward the needle. You pull back on the plunger and hear a hiss as the fluid in the needle is sucked back into the fluid in the syringe. (PAUSE). Keeping the syringe inverted, you gently push on the plunger. As you watch the fluid moving closer and closer toward the needle, you hear nothing as the air in the syringe joins the atmosphere. You continue to push the plunger and watch the tip of the needle. Soon, a bubble of fluid appears at the bevelled needle. You stop pushing the plunger on the syringe so you don't squirt Gravol in the air and contaminate your needle. You turn your syringe over the sink and continue expelling fluid until you reach the required 2 mls. of medication. You reach for the cap and place it on your needle. You put the syringe on the tray, add an alcohol swab, perform the last medication check, and take your supplies to the patient's bedside.

At the bedside, you identify your patient, check for allergies, and landmark for an I.M. injection. (PAUSE). With your injection supplies within close reach, you loosen the cap off the needle, but don't remove it. You open your alcohol swab. You notice that everything is ready to
go on your tray. (PAUSE). You swab the injection site with the alcohol. Starting in the middle of the area you landmarked for the injection, you swab in a continuous circular motion with each circle larger than the last. You notice that your alcohol has left a faint liquid design similar to the appearance of an element on a stove. You place the swab in the center of the swabbed area. The tip of your alcohol swab is pointing to the spot where you want to inject.

With your thumb and forefinger on your non-dominant hand, you taught your patient’s skin. The skin pulls tight and smooth. You keep this hand in position on your patients warm soft skin. With your dominant hand you reach for the nearby syringe. The cap falls off the needle onto the tray as you point the syringe downward. With the needle at a 90 degree angle to your patient, you quickly dart the needle into the skin. A fine "pop" is heard as the needle penetrates the skin. Your patient appears unaware that the needle is in. How are you feeling? (PAUSE). Let go of your patient’s skin with your other hand. Use that hand, instead, to stabilize your syringe. Aspirate the plunger with your dominant hand to see if any blood appears. None does. You notice that it takes quite a bit of pressure to pull back on the plunger. All that appears is a bubble. You now know that it’s O.K. to inject the Gravol. Slowly, you push the plunger and watch the liquid leave the syringe and enter your patient. Once all the solution is injected, you re-taught your patient’s skin with your non-dominant hand, quickly remove the needle, and rub the injection area with the alcohol swab. You throw your syringe and needle into the yellow sharps box. Return your focus to the classroom and open your eyes when you are comfortable. The visualization experience is complete.
Appendix L: Instructions for Video-Taping Sessions
Hi, I’m Connie Klimek. I’m a master’s student in nursing and, as you know, I’m doing research on the use of visualization as a teaching strategy. I have to read the following as it’s written so that I don’t miss anything and so that the other video-taper at the V.H. site and I say everything the same to all students in the study.

You have been assigned to either the treatment or control group in this study. I don’t want to know which one you’re in. But, I do want to inform you that if you never received the visualization experience and would like to get the treatment (or view your video-taped injection) at a later time, I’d be happy to arrange a time to meet with you.

First, I need to know your student number (write it down). Please state it slowly to the camera. If you’d like to wear a mask for the camera to conceal your identity, you’re more than welcome. I will be the only person who will view your video. Please do everything you’d do while giving an I.M. injection in "real life", except landmarking. This is just more practice time, you need not do this skill perfectly. Do your best. It shouldn’t take more than 10 minutes. I will stop you after 10 minutes is over. If there is anything you’re doing that the camera may not know/see, please state it as you do it (i.e. "I’m removing an air bubble, now"). Any questions? I won’t speak during the video and I’ll try to just video tape your hands.