

INJECTION GIVING: THE EFFECT OF TIME LAPSE BETWEEN LEARNING AND ACTUAL PRACTICE ON STUDENT CONFIDENCE

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Beginning nurse practitioners, regardless of their educational preparation usually seek initial employment in hospitals at the staff nurse level (Kramer, 1978; National League for Nursing, 1978). In that setting, the most common criterion for job performance tends to be skill competence (Ford, 1977; Hurd, 1979; Kitzman, 1974). Confidence in psychomotor skill is also identified as a significant factor in successful work performance for new graduates (Kramer, 1970). Furthermore, it has been shown that, although competence in psychomotor skills may be adequate, if self-confidence is severely lacking there is a significant negative pressure on work performance (Hurd, 1979; Kaelin and Bliss, 1979). Therefore, it behooves the nursing educator to be accountable not only for the graduates' skill competence, but also for their confidence in performing nursing psychomotor skills.

This article describes a study that investigated the degree to which time lapse between laboratory learning and actual practice affects students' perceived success in injection-giving. More specifically, we sought to determine how soon after laboratory learning students should give an injection to a patient, in order to experience the best possible success.

Background from the Literature

Several factors are believed to affect the retention of initial psychomotor skill learning. "Knowledge of results" is often assumed to be among the most potent of these factors. This form of information feedback is also believed to be profoundly important in determining the nature of learned psychomotor knowledge that is retained. Specificity, precision, and immediacy of critical feedback protect against the acquisition of erroneous information of skill execution habits which would impair correct learning (Welford, 1976).

The length of the time between original learning and recall is related to the degree to which "forgetting" is permitted to occur. When a psychomotor skill has been partially learned, brief time lapses may actually improve skill performance through the processes of "reminiscence" or "mental practice" (Singer, 1980). Forgetting is frequently a product of the degree to which activities

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occur between learning and later performance. The strongest inhibitor to learning is the introduction of new information that is moderately similar to target skills (Cratty, 1967). Motor tasks with a cognitive component, such as injection skills, are subject to this interfering effect because of the vast amount of cognitive information daily confronting the average learner (Schmidt, 1975).

The mechanisms and principles of transfer of learning are less well understood. High anxiety is believed to interfere with the ability to adapt learned skills to novel situations (Cratty, 1967). Evidence is contradictory as to whether initial learning for the purpose of transfer should occur in ideal learning conditions, or in those that most closely approximate reality (Schmidt, 1975). The most common theory of transferability relies upon generalization of capacities to comprehend principles and to solve problems in alternate situations. Singer (1980) reports, however, that new evidence invalidates the applicability of this theory, although it has been used as a theoretical basis for much of classroom teaching strategy.

Emotional and attitudinal variables also have an impact upon both initial learning and transfer of skills. McCaughan and Gimbert (1981) claim that expecting to succeed is an attitude conducive to optimal retention. Lawther (1968) suggests that initial successes at skill performance increase the learner's motivation to excel, particularly when initial success allows such ego reinforcements as prestige and status within the reference group. Thus confidence not only facilitates initial learning, but also triggers on-going motivation to excel.

Most theorists recognize that optimal conditions, timing, and feedback schedules for each specific psychomotor skill must be determined independently (Jensen, Picado & Morenz, 1981; Sage, 1977; Singer, 1980). Much of the research on factors influencing retention and transfer has focused on generalized verbal learning or the learning of discrete mechanical motor tasks (Sage, 1977). Thus, the applicability of general psychomotor skill principles to such complex and emotionally-charged nursing procedures as injections is a relevant focus of study. By examining the actual practice of such skill learning, the applicable principles and factors may be identified.

Research Questions

The following research questions were tested:

1. Will students who are able to give injections within one to two weeks after laboratory learning rate themselves as more successful than students who have to wait more than two weeks before giving an injection to a patient?
2. Will students who are able to give injections within three to

four weeks after laboratory learning rate themselves as more successful than students who have to wait more than four weeks before giving an injection to a patient?

3. Will students who are able to give injections within five to six weeks after laboratory learning rate themselves as more successful than students who have to wait more than six weeks before giving an injection to a patient?

Definition of Terms

For purposes of this study the following terms are defined:

Administration of medication: accurate, safe and efficient preparation of medication following the laws and regulations governing drugs, including giving the correct medication, to the right patient, at the right time, via the right route.

Aseptic technique: use of sterile technique in parenteral medication administration including clean hands, sterile hypodermic needle and syringe, sterile medication, and disinfected injection site.

Injection-giving skill: ability to give a parenteral medication via intramuscular or subcutaneous route.

Injection site: a body part for giving an intramuscular or subcutaneous injection, that assures optimal absorption and prevention of a reaction that could cause pain, tissue damage, or disfigurement.

Performance: insertion of a hypodermic needle through the skin and deposition of medication into the correct tissue (subcutaneous fat or muscle) in such a manner as to reduce pain and tissue damage.

Success: student's perception of the degree of skill competence as measured by the score on the injection rating scale.

Method

Forty-six female students (70% of eligible subjects), ranging in age from 17-25 years (mean age 19.6), volunteered and were included in the study. All participants were second-year university nursing students who had not previously administered parenteral medications.

For the first 6 injections indicate your level of success by circling the number that best describes your performance:

Date Injections given:	Date of 1st Injection	Date of 2nd Injection	Date of 3rd Injection	Date of 4th Injection	Date of 5th Injection	Date of 6th Injection
Administration of Medication						
1. Instructor had to correct me	1	1	1	1	1	1
2. made an error and corrected it myself	2	2	2	2	2	2
3. correct, but hesitant performance	3	3	3	3	3	3
4. faultless performance	4	4	4	4	4	4
Aseptic technique						
1. contaminated equipment and instructor noticed	1	1	1	1	1	1
2. contaminated equipment and corrected myself	2	2	2	2	2	2
3. sterile technique but clumsy	3	3	3	3	3	3
4. sterile technique	4	4	4	4	4	4
Injection site						
1. was unable to find correct site	1	1	1	1	1	1
2. instructor had to help find site	2	2	2	2	2	2
3. found correct site after some difficulty	3	3	3	3	3	3
4. found correct site easily	4	4	4	4	4	4
Performance						
1. unable to give injection	1	1	1	1	1	1
2. instructor helped to penetrate skin	2	2	2	2	2	2
3. felt clumsy penetrating skin	3	3	3	3	3	3
4. injected easily, and faultlessly	4	4	4	4	4	4

Figure 1

A questionnaire (see Figure 1) was developed to monitor the confidence and competence of injection-giving skills. It contained a rating scale asking students to evaluate their own performance in four areas: 1) medication administration, 2) aseptic technique, 3) injection site, 4) actual performance. Ratings ranged from "Instructor had to correct me", the lowest (1), to "Faultless performance", the highest rating (4). No names or other identifying data were included in the questionnaire.

Test-retest reliability was determined by having thirteen students (who had learned injection giving the previous semester) score their performance on two injections immediately after the performance, two days later, and one week later. Pearson correlation coefficients between the mean scores at 2 days and one week were .96 (N=13) and .78 (N=12) respectively.

Content validity of the instrument can be assumed to have been met in two ways: items on the questionnaire were based on skill evaluation tools used in three nursing schools; items common to two of the three schools were included in the questionnaire. Three experienced nursing instructors judged the instrument to be a valid measure of confidence and competence in injection skills.

Procedure

Students at our university are initiated to acute care nursing during the second year of the program. During the eight-month academic year, clinical experience was offered on medical-surgical and psychiatric wards. Groups of seven to nine students (randomly assigned to these groups) followed different rotations of six to eight weeks. The many psychomotor skills to be learned were taught to all students at the same time. Thus, students who learned parenteral medication administration while they were on a surgical ward had the opportunity to give an injection soon after they had learned the skill. However, for students who were on a psychiatric ward while this skill was taught, the opportunity might not have presented itself till the next rotation, a few weeks later.

Basic injection skills were taught at a parenteral medication administration laboratory. This laboratory was given in two three-hour lessons, which included lectures, demonstrations, and supervised practice of different types of injections. Students were also encouraged to practice using a syringe at home and/or during scheduled practice time. At the end of the second laboratory session, students had the opportunity to give each other an injection, or alternatively, give an injection to a "model". Students practised until the instructor deemed them "safe" to give an injection to a patient in the hospital.

Before the first laboratory session, the study was explained to students and the questionnaires were distributed. Students were asked to score their own performance for each of the first six

injections they gave in the clinical area. Completed questionnaires were presumed to imply consent to participate. This procedure was accepted on ethical grounds by the university's Screening Committee.

Limitations

Generalizability of the findings is limited by the following factors. First, the time lapse between learning and giving of injections was not experimentally controlled and might have been due to other influences than chance. Although the opportunity to give injections was largely dependent on the subject's clinical rotation (students on a surgical ward could hardly have avoided giving an injection, while students on a psychiatric ward had little chance to use this psychomotor skill), and although assignments to different rotations were based on random distribution, it is conceivable that students more adept at psychomotor skills sought and thus found the opportunity to give injections sooner than the less skillful or confident students.

Results

Secondly, the degree of mastery of the skill during laboratory practice, or through independent practice by an individual student, was not independently assessed and may have been a confounding factor.

The students were divided into four groups according to the length of time between learning to give an injection and giving the first injection to a patient.

Twenty-one students who gave their initial injection within two weeks were placed in Group I. Ten students who gave their first injection within three to four weeks were placed in Group II. Eight students who gave their initial injection within five to six weeks before giving an injection to a patient were placed in Group IV.

The time frame for the series of six injections varied from a few hours (one subject in Group II gave all six injections on the same day) to more than six weeks. The majority of subjects (48%) gave the six injections within five to six weeks. Time intervals between injections also varied from a few hours to a maximum of four weeks. All students except one were able to give the first two injections within a week. There were no systematic differences between the groups of this variable.

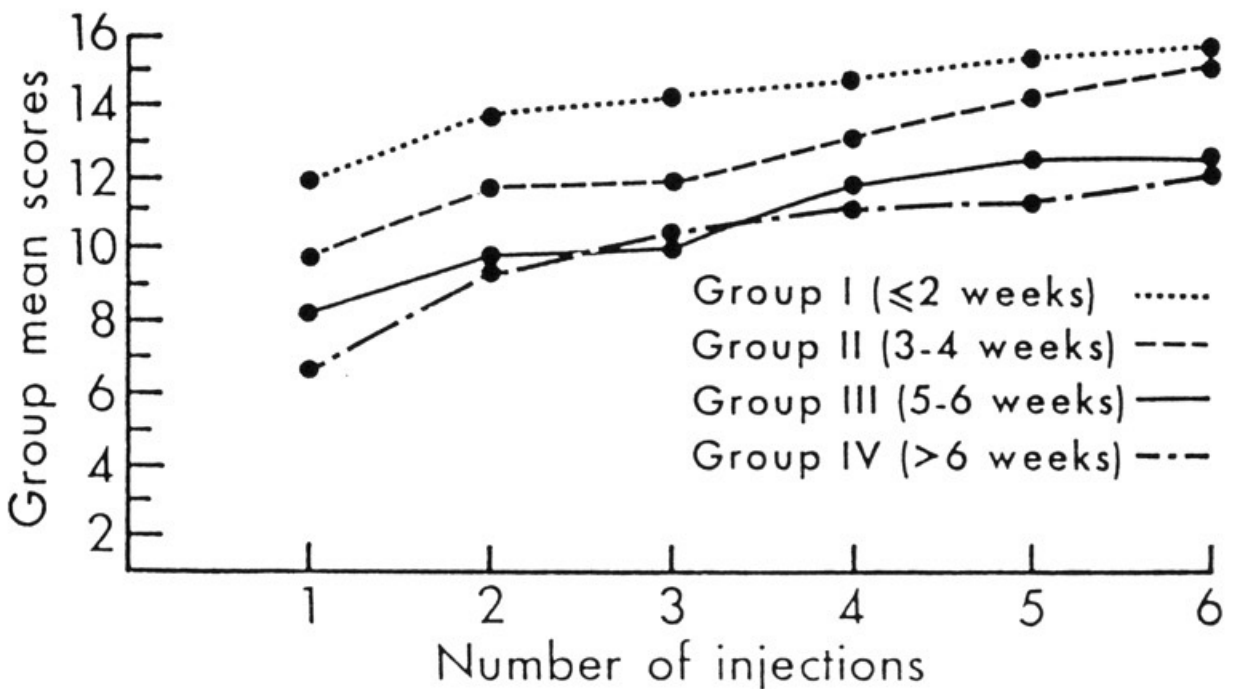
The results of the questionnaire were tabulated to show each student's over-all assessment of her "success". Individual scores for all six injections combined varied from 49 to 93, out of the possible maximum score of 96. Analysis of variance indicated that

there was a statistically significant difference between the group means ($F(3,42)=28.6, p < .001$). Mean scores were highest for Group I ($M=85$) and lowest for Group IV ($M=61$). Mean scores for Group II and III were 77 and 67 respectively. Scheffe's procedure for the comparison of multiple means indicated the mean for Group I differed statistically from the mean from Group II ($p < .05$), and the Group II mean differed from that of Group III ($p < .05$). The difference between the Group III and IV means was not statistically significant.

In view of the small number of subjects in Groups II, III and IV, the three groups were collapsed into Group II (subjects who gave their first injection after two weeks), and the 25 subjects' scores for each of the six injections was compared to the 21 subjects' scores in Group I (subjects who gave their first injection before two weeks). Analysis of variance using a repeated measurement design indicated significant difference between subjects' scores in the two groups ($F(1,44)=44.3, p < .001$). Difference in scores from one injection to the next was also significant ($F(5,220)=59.8, p < .001$). Finally, the group times injection interaction was significant as well ($F(5,220)=3.3, p < .007$).

Looking again at the four original groups when each of the six injections was considered separately, the same general relationship among groups was obtained: Group I achieved better scores at each injection than Group II. Group II achieved better scores than Group III, and Group III in turn achieved better scores than Group IV. (See Figure 2).

Figure 2



Discussion

The results clearly answered the research questions: the sooner students were able to apply their newly learned injection skill to a patient, the more confident they felt in their ability to apply the skill. This remained true even though the time lapse between subsequent injections was sometimes extended. In this study, the time before giving the first injection appeared to be the most significant factor. Time lapse between giving the first and giving subsequent injections did not significantly influence success in giving a parenteral medication.

The above findings can be explained by considering the literature on retention and forgetting. Cratty (1967) and Schmidt (1975) both demonstrated that forgetting can occur through retroactive inhibition, especially in motor tasks with a cognitive component. Since the difference between study groups in the degree of time lapse between laboratory learning and clinical trial of the injection, and, since in any nursing program the acquisition of moderately similar knowledge increases with time, the potential for retroactive inhibition increases proportionately. The findings of this study thus might be attributed to "forgetting".

However, differences in retention might also have contributed to the results. Theorists agree that feedback is most effective in promoting retention when it is "meaningful" to the learner (Singer, 1980). If experience in laboratory learning does not meet this criterion of meaningfulness to the learner, the feedback provided may be inadequate for skill retention. It is possible that no feedback short of actual clinical success meets the injection-learners criteria for meaningfulness.

Confidence arising from initial success is likely to promote skill retention (McCaughan and Gimbert, 1981). Students who experienced early initial successes were better able to retain their skill than students who had to wait, even when the time lapse between subsequent injections was lengthy. Since the target skill is often perceived by students as being crucial to clinical nursing competence, early success may well have brought peer- and self-esteem to those lucky enough to perform early clinical skill trials. Such ego involvement would be highly conducive to the motivation to excel, thus explaining why long waiting after the initial trials seemed not to deter subsequent successes.

The findings of this study strongly suggest the advisability of encouraging clinical execution of the injection within two weeks of the laboratory learning experience.

Most psychomotor skill research findings described in the literature are concerned with skill transfer in discrete motor tasks, verbal learning, and sports or military activities. None of these include the emotional and motivational properties inherent in many

of the intrusive nursing skills such as giving injections, catheterization, or changing of dressings.

Although nursing has long been actively involved in research that compares and evaluates various learning strategies, rarely has the criterion of success been that of actual transfer to practice settings. In view of the increased use of campus laboratories as the initial training ground for many psychomotor skills, the ideal timing and scheduling principles for transfer of skills to the clinical setting should be tested.

In summary, this investigation points out the great need for further studies of nursing psychomotor skill learning. Only such studies could effectively generate a body of specific knowledge that would provide students with efficient and effective psychomotor skill learning experiences.

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RÉSUMÉ

Injectons: Effets du temps écoulé entre l'apprentissage en laboratoire et la pratique réelle sur l'assurance de l'étudiant

L'effet du temps qui s'écoule entre l'apprentissage en laboratoire et la pratique clinique des injections a été vérifié chez 46 étudiants de deuxième année d'un programme universitaire de sciences infirmières. Les sujets ont été répartis en quatre groupes selon le temps écoulé entre l'apprentissage et l'administration d'une injection à un malade. Six injections ont été évaluées par les sujets selon une échelle mis au point pour l'étude en question. Les résultats ont nettement démontré que plus vite les étudiants mettaient en pratique les compétences qu'ils venaient d'acquérir, meilleures étaient leurs aptitudes. On a considéré que l'assurance qu'ils tiraient de leurs premiers succès était l'explication la plus probable des succès durables dont faisaient état les étudiants qui avaient mis très tôt en pratique leurs compétences.