

UNIVERSITÉ DE SHERBROOKE

**Use of Think-Aloud
in Teaching Physical Assessment
to Nursing Students**

par

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UNIVERSITY OF SHERBROOKE

Faculty of Education

Use of Think-Aloud in Teaching Physical Assessment
to Nursing Students

by Rebecca Dyck

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ABSTRACT

The focus of this research was the teaching of physical assessment to nursing students. A think-aloud method was developed, in which the teacher and students articulated their observations and thoughts as they examined patients. Eleven second-year college students and their instructor in Maternal-Child Nursing participated, assessing infants and young children in two Montreal hospitals. The project was implemented throughout 1996, and data was obtained through individual and group interviews, student journals and written reflections, exit and entry questionnaires, and the teacher's log.

Analysis of the data showed that the use of think-aloud had created a positive learning environment which embodied the main characteristics of cognitive apprenticeship. Students reported increased self-confidence and identified the crucial role of peer participation. Their assessment skills improved and included the transfer of think-aloud to silent assessments. It is recommended that think-aloud be used in these and other clinical instruction settings.

RÉSUMÉ

Dans les soins infirmiers apportés aux patients, un examen physique complet et exact est de la première importance. Les étudiants doivent recueillir les données sur le patient, déterminer les éléments clés, établir les priorités et des liens entre différentes données, faire des déductions sensées et formuler une hypothèse. C'est à ce moment seulement qu'ils seront en mesure de planifier et apporter les soins infirmiers appropriés. Il est ardu d'apprendre à bien évaluer un patient et les difficultés des étudiants à cet égard sont abondamment illustrées dans les exemples cliniques et la littérature de la profession.

L'évaluation physique est enseignée dans tous les programmes de sciences infirmières, mais les résultats obtenus par les étudiants sont souvent peu satisfaisants, vu que l'enseignement met habituellement l'accent sur l'acquisition par les étudiants de connaissances dans leur discipline et d'aptitudes psychomotrices plutôt que sur la formation des processus de réflexion qui interviennent dans cette première étape cruciale du processus infirmier. Ainsi, les étudiants n'ont pas de modèles de raisonnement à observer et reproduire.

Toutefois, si l'expert réfléchit à voix haute alors qu'il fait une démonstration de la tâche à accomplir, et si les novices pensent à voix haute alors qu'ils tentent de l'exécuter, les processus de réflexion en deviennent accessibles et l'instruction devient un exercice de raisonnement. Cette théorie de l'apprentissage cognitif forme la base du présent projet de recherche.

La recherche avait pour but l'élaboration et la mise en pratique d'une méthode de réflexion à voix haute pour enseigner l'évaluation physique des nouveau-nés et des jeunes enfants à des étudiants de deuxième année en sciences infirmières au niveau collégial. L'étude s'est déroulée dans le contexte de deux hôpitaux montréalais et a été menée durant le stage clinique des deux semestres de 1996, lesquels étaient composés de quinze semaines comprenant chacune deux jours de travail clinique. Le premier groupe comprenait cinq

étudiants et le deuxième, six. La recherche avait pour but de décrire et comprendre l'usage de la réflexion à voix haute dans l'enseignement de l'évaluation physique et de déterminer si cette méthode pouvait contribuer à créer un environnement d'apprentissage concordant avec les principes de l'apprentissage cognitif.

Les données furent obtenues en utilisant des entrevues individuelles, des discussions en groupe, les carnets des étudiants, le livre de bord du professeur, les questionnaires d'admission et de congé et les observations écrites des étudiants. Ces données ont été analysées de deux façons. D'abord, on en a dégagé les thèmes principaux. Puis on y a également recherché la présence des facteurs suivants qui sont des composantes de l'apprentissage cognitif, d'après le modèle proposé par Collins, Brown et Newman (1989):

1. Sociologie de l'apprentissage, comprenant l'apprentissage en situation, la culture de pratique experte, la motivation intrinsèque, la collaboration et la compétition;
2. Séquence de l'enseignement, structuré de manière à augmenter la complexité et la diversité, et à présenter les aptitudes globales avant les aptitudes ponctuelles;
3. Contenu de l'enseignement, c'est-à-dire connaissances de la discipline, stratégies heuristiques, stratégies de contrôle métacognitif, de même que diverses stratégies d'apprentissage;
4. Méthodes d'enseignement qui incluent la démonstration, l'orientation, l'encadrement, l'articulation et la réflexion.

La principale limite de l'étude venait du fait qu'il n'est pas toujours approprié que des professionnels de la santé expriment tout haut leurs pensées en présence du patient, étant donné qu'une telle pratique pourrait semer de la confusion et de l'inquiétude chez le patient. Toutefois, ce problème a pu être évité en limitant les réflexions à voix haute à l'évaluation physique des nouveau-nés et des jeunes enfants, incapables de comprendre les mots utilisés et dont les parents n'étaient pas présents lors du processus d'évaluation.

L'étude a pris la forme d'une recherche participative active, c'est-à-dire que le chercheur ayant conçu le projet était également le professeur qui le réalisait en clinique. Les étudiants ont été activement engagés dans l'élaboration de la structure de la recherche ainsi que dans les réflexions continues sur son impact, de sorte que l'étude comportait un changement de l'expérience vécue de tous les participants. Il fut établi que cela a mené à une compréhension étendue et toujours mise en contexte de l'emploi de la réflexion à voix haute dans l'enseignement de l'évaluation physique.

Les conclusions tirées des données ont confirmé que l'emploi de la réflexion à voix haute a créé un milieu d'apprentissage positif et qu'il avait satisfait à tous les critères de l'apprentissage cognitif. Des résultats très nets de meilleure estime de soi et de plaisir à utiliser cette méthode ont été notés chez les étudiants et le rôle crucial de la participation des pairs était évident. Les compétences des étudiants en matière d'évaluation se sont accrues tout au long de l'étude, et le transfert de la réflexion à voix haute aux évaluations faites en silence a été encouragé. Il est recommandé que la méthode de réflexion à voix haute soit utilisée dans d'autres contextes cliniques et par divers instructeurs en sciences infirmières, afin d'établir de façon plus large son utilité dans l'enseignement de l'évaluation physique.

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PREFACE

I have worked in nursing for the past twenty-two years, most of them spent teaching pediatric nursing. The curricula structuring my teaching have varied greatly from country to country and from year to year, as conceptual frameworks change and pedagogical approaches are refined. But just as the positive elements of human caring and professionalism remain constant, so also the problematic aspects of learning the art of nursing keep recurring. A major hurdle for students is learning physical assessment, which is one of the most essential components in their development into competent nurses. I have been searching for an effective method of teaching this skill for a long time. When the opportunity arose to pursue the subject as part of an M.A. research, I was delighted.

The University of Sherbrooke, in Quebec, offers a master's degree programme that includes courses on various facets of education and a thesis project of original research. For this I designed a method of teaching physical assessment which, to the best of my knowledge, is the first methodological use of "think-aloud" in nursing. For one year I used this approach with my students, gathering data from them and from my own reflections.

This report presents the results of that experience. The text is organized into five chapters: introduction, review of the literature, methodology, data analysis, and conclusion. Bibliographical references and appendices then follow.

First Chapter: Introduction to the Research Problem

The reader is introduced to the topic of physical assessment and the usual manner in which it is taught to nursing students. Some of the most common problems encountered are presented via anecdotes from my clinical experience. The nursing literature addressing these difficulties is cited, along with the argument for the necessity of research on teaching physical assessment. The nursing process is explained and the thinking skills involved in physical assessment are outlined. I suggest that a possible solution would take the form of

what is termed cognitive apprenticeship. One of its key components is the articulation of thoughts: if the expert thinks aloud while demonstrating a task, and the novices think aloud while attempting to perform it, the thinking processes are made accessible and the instruction becomes an apprenticeship in thinking. I propose the application of this principle to the teaching of physical assessment, with the research problem focussing on describing and understanding the use of think-aloud in real situations of teaching physical assessment.

Second Chapter: Review of the Literature

In order to situate the research project within its theoretical parameters, a review of the pertinent literature is presented. The major elements of constructivism and situated learning are outlined, with a brief overview of their historical developments and current interpretations. An examination of the crucial role of language and perception in the physical assessment task is undertaken, although I recognize that a thorough study of these aspects would require lengthy dissertations well beyond the scope of this report.

Central to this project, the theory of cognitive apprenticeship with a description of its identifying characteristics follows, and its relationship to teaching nursing skills is explored. Then a sampling of published accounts of applications of cognitive apprenticeship methods is provided.

Third Chapter: Methodology

This section explains the way in which the research was conducted. The project was designed in a participatory action format, involving two groups of second-year students in Maternal-Child Nursing at the CEGEP level. The implementation took place in the nursing units of two Montreal hospitals in 1996, and was conducted throughout two semesters of 15 weeks each with two clinical days per week. The data was obtained through individual interviews, group discussions, student journals and reflection sheets, exit and entry questionnaires, and the teacher's log. My own role as active participant is described; I

recognize the dangers inherent in such direct involvement but believe that the advantages outweighed the risks.

The main limitation to the study was imposed by the social constraints on a health care professional's articulation of thoughts in the presence of the patient. However, this problem was avoided by limiting think-aloud to the physical assessment of infants and young children who did not understand the words being said and instead appeared to enjoy the attention they received in the process of being assessed.

Fourth Chapter: Data Analysis

The data is analyzed from two points of view. First, the facts collected are compared to those characteristics of a positive learning environment which are the hallmarks of cognitive apprenticeship. According to Collins, Brown et Newman (1989), these are grouped into four categories:

1. The sociology of learning, with reference to situated learning, the culture of expert practice, intrinsic motivation, cooperation and competition;
2. The sequence of instruction, with attention to increasing complexity and diversity, and presenting global before local skills;
3. The content of instruction, emphasizing domain knowledge, heuristics, metacognitive control and learning strategies;
4. Teaching methods, including modeling, coaching, scaffolding, articulation, reflection, and exploration.

Then the data is reviewed for emerging themes. This analysis revealed much overlap with the described characteristics, as the students had frequently commented on precisely the aspects noted above. To avoid repetition, the major themes are summarized in table form and classified as affective factors, teaching/learning strategies, and performance outcomes. In addition, I use a graph to compare the entry and exit questionnaires and show an increase in

students' perceptions of their own comfort level and competence in performing physical assessments.

Fifth Chapter: Conclusion

Based on the data analysis, it is apparent that the use of think-aloud created a positive learning environment and met the criteria of cognitive apprenticeship. In this final chapter I offer reflections on the process, such as think-aloud's impact on the students' mental sets, the students' increased self-confidence and enjoyment of this approach, the dynamic nature of action research, the crucial role of peer participation, the students' improved assessment skills and the successful transfer of think-aloud to silent assessments.

Finally, I offer some recommendations that grow out of this study. Most importantly, think-aloud needs to be applied in other clinical settings and by a variety of nursing instructors, in order to more broadly establish its usefulness in teaching physical assessment. Further research into applications of think-aloud in particular and cognitive apprenticeship in general should be conducted, as the project reported here represents only a small first step in this exciting new field of inquiry.

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I thank my students, whose participation in this research was essential and whose constructive feedback I appreciated on a professional and a personal level. Many thanks also to Tom Holzinger for technical support and computer wizardry. Above all, I would like to express my gratitude to my sons Sasha and Misha. Without their unwavering confidence and constant encouragement, this opus would never have been completed.

CHAPTER I

INTRODUCTION TO THE RESEARCH PROBLEM

In the nursing care of patients, a thorough and accurate physical assessment is fundamental. The content of the assessment task is taught in all nursing programs, but student performance outcomes are often unsatisfactory, as the teaching format usually focuses on students' acquisition of domain knowledge and psychomotor skills rather than on shaping the thinking processes involved. In this research project a teaching method called think-aloud is presented. In the context of a cognitive apprenticeship approach, it may be useful in helping student nurses develop good physical assessment skills.

To introduce the project, an elaboration of the meaning of physical assessment and related teaching practices follows, as well as examples of problematic student performance in this area. Some solutions suggested in the literature are briefly outlined. Physical assessment is then situated in the context of the nursing process and the requisite thinking skills are examined. The relationship of assessment to cognitive apprenticeship and to think-aloud is explained, and the research problem is presented.

1. Physical Assessment

Physical assessment is the detailed examination of a patient for the purpose of obtaining and analyzing health data. The nursing functions include four techniques: inspection (observing), palpation (feeling body surfaces with the fingers), percussion (striking the fingers against body surfaces), and auscultation (listening to body sounds) (Kozier & Erb, 1995). Together with the health history and laboratory measurements, the physical assessment provides information which forms the basis for all decisions regarding the choice and implementation of nursing interventions. It is the first step in the nursing process and all subsequent phases -- planning, intervention, and evaluation -- "depend on the quality of the assessment data for their effectiveness" (Nurse's Reference Library, 1984, p. 2).

The assessment task comprises two distinct components: the collection of data and the analysis of data. To verify and interpret the data accurately, a nurse must be competent not only

in performing the physical examination but also in evaluating the information obtained and integrating it with the health history and lab data. This makes assessment a challenging skill to master because students need to learn to observe keenly, possess enough of a knowledge base to distinguish pertinent from irrelevant observations, compare findings to known norms, and analyze the results in a manner that will lead to the planning of a relevant response. In addition to cognitive and psychomotor skills, physical assessment requires the development of affective skills for appropriate and empathetic behaviour towards the patients being examined (Morton, 1993).

Milner and Collins (1992) express a sense of urgency regarding students' mastery of physical assessment:

Competency in client assessment is becoming increasingly important. Rising patient acuity levels, larger needy populations, and tremendous increases in costs are placing unprecedented responsibility on nurses to make independent decisions. These decisions are often critical in terms of patient outcomes. Nurse educators have the responsibility of preparing students who are well equipped to perform the assessment skills that are deemed necessary for practice as competent professionals. (p. 186)

2. Teaching Physical Assessment

Physical assessment is taught in all modern nursing education programs and is included in standard curricula. Frequently used standardized assessment guides are Gordon's (1987) *Functional Health Patterns* and the North American Nursing Diagnosis Association's (1992) *Human Response Patterns*, both of which follow outlines of patient functions such as perception, elimination, or coping with stress. Other customary approaches are an anatomical head-to-toe pattern or a body systems pattern (Seidel, Ball, Dains, & Benedict, 1995). The commonality lies in telling students what to look for and how to obtain the data in a systematic, orderly manner.

A review of the literature on physical assessment reveals that much has been written about the physical signs and symptoms which the nurse should evaluate. Every current nursing textbook presents basic assessment information. In addition, books dedicated exclusively to the subject, by authors such as Jarvis (1996), Morton (1993), and Seidel *et al.* (1995), explain in

detail the procedures to be used and the facts to be ascertained. The emphasis is generally on human anatomy and physiology in health and disease. Some texts offer extensive assessment forms to be used as guidelines (Mayfield, Bond, Browning, & Evans, 1980).

At many advanced levels, such as for the baccalaureate degree or nurse practitioner license, specialized courses on physical assessment are required. At the CEGEP level, which prepares students to take the basic licensing exam for nurses, assessment content is integrated into the general nursing courses. At Dawson College, for example, an initial exposure to the topic of patient assessment is provided in the introductory course of the first semester (Nursing 180-110). The remaining courses during the three-year programme acquaint the student with a range of clients, such as pediatric and adult, medical and surgical, psychiatric and geriatric, and include the assessment content pertinent to each area. This material is presented in the classroom setting. Lab practice sessions follow, in order to reinforce the information; for example, students listen to audiotapes of respirations in order to learn to recognize problematic sounds (Dawson College, 1996/97). Students also do clinical work corresponding to the area of nursing being studied.

The second-year Dawson course on Maternal-Child Nursing (180-310/410) similarly introduces students to the specific assessment factors important in its two related fields: Pediatrics, which pertains to the nursing care of children from newborn to 18 years of age; and Obstetrics, which is the nursing care involved with pregnancy, childbirth, and the immediate postpartum period. Students have 90 hours of classroom lectures on these subjects, participate in 30 hours of lab practices, and give supervised nursing care to pediatric and obstetric patients in a variety of Montreal hospitals. The clinical component consists of 150 hours, done on Thursdays and Fridays throughout the semester. At mid-semester the pediatric and obstetric groups change places, so that by the end of the term all students have worked in both areas. The textbooks used in this course, *Essentials of Pediatric Nursing* (Wong, 1993) and *Essentials of Maternal-Newborn Nursing* (Ladewig, London, & Olds, 1994) list assessment criteria for the various patient conditions discussed.

3. Students' Performance of Physical Assessment

Problems arise when students apply the theoretical assessment approaches in the clinical setting with real patients. Student nurses tend to make common errors, most notably

- a) missing important data clues;
- b) misinterpreting the data collected;
- c) prioritizing incorrectly;
- d) failing to base nursing responses on the assessment data;
- e) neglecting the psychosocial component of patient assessment.

Students' errors in judgement can have dangerous consequences. Some examples from this researcher's clinical practice follow:

- A student methodically examines a patient from head to toe while he is gasping for air and becoming cyanotic; in the pursuit of complete data the main problem has not been prioritized.
- In order to evaluate a patient's gait a student asks her to ambulate, despite the presence of a red swollen area in her leg which indicates a blood clot; the sequencing of data collection has not been adjusted to the patient's symptoms.
- In responding to a patient's request for analgesia a student evaluates the intensity of pain and prepares the corresponding medication. When the patient reports that the pain has lessened spontaneously, the student administers the drug anyway; the assessment act is viewed as static rather than dynamic.
- After measuring a child's height and weight a student concludes that the patient is malnourished, without considering that he may be genetically programmed to these dimensions; a rigid adherence to "norms" narrows the interpretative scope.
- When a pediatric patient fails to speak with the examiner at the expected level, a student decides that the child is developmentally delayed, without acknowledging that he is terrified of the hospital; an exclusive focus on the physical findings negates the social dimensions of the interaction.
- In assessing an infant a student notes that his hands and feet are blue and that he is crying, but does not bundle him more warmly; the causal connection between assessment and nursing action is missing.

- For an acutely ill patient with abdominal cramping, a student gathers data and carefully charts it and then is surprised when the nursing staff reacts with an indignant flurry of activity; a rigid separation of the processes of data collection, analysis, and intervention preempt an immediate response to a nursing emergency.

Discussions this researcher has held with numerous nursing instructors have revealed a common theme of frustration with students' inadequate assessment skills and apparent lack of clinical application of their supposed theoretical knowledge. This impression is confirmed in the professional journals, where one finds articles decrying the paucity of students' physical assessment skills (Milner & Collins, 1992) as well as the ineffective teaching methods used. For example, Bowman and Dult (1993) conducted a survey of accredited nursing programs and found:

Unfortunately, it would appear that health assessment is being taught from a physician's perspective, not as a source of data for application of the nursing process, nor for perceiving nursing as an art and science. (p. 6)

4. Recommendations in the Literature

Presently there are very few published suggestions for improving the unsatisfactory situation in nursing education regarding the teaching/learning of physical assessment. Examples of some of the solutions suggested in the literature are:

1. Following the example of medical schools, DeYoung (1990) proposes the use of live simulation by healthy persons who are trained to act specified roles of sick patients.
2. Milner and Collins (1992) offer a one-page data guide for students to follow as they conduct physical assessments of patients. The authors comment that "acquiring the knowledge and skills necessary for systematic assessment is a difficult and time-consuming process... Both students and instructors become frustrated by the sheer complexity involved" (p. 186).
3. For graduate students in specialization programs, in-depth courses on physical assessment are becoming mandatory at many universities (Hagopian, Gerrity, & Lynaugh, 1990).

4. A survey in 1988 of the "state of the art" of teaching physical assessment in undergraduate programs concluded that generally, the teaching of assessment skills is "in the process of evolution" (James & Reaby, p. 52) and the authors encourage continued improvement of assessment pedagogy.

However, there is a clear lack of current projects on the undergraduate level, and little evidence of overall success in teaching physical assessment effectively. As Hagopian *et al.* (1990) describe, faculty "at every level of nursing education struggle with the problem of teaching assessment" (p. 272).

5. Physical Assessment and the Nursing Process

The nursing curriculum in Quebec is organized according to on-going themes called "threads", which give a coherent structure to the various subjects studied during the completion of a nursing program. Physical assessment is categorized under the thread of "the nursing process" (Dawson College, 1996/97). This term refers to the systematic and deliberative problem-solving method used by nurses to meet the needs of the patient (Black & Matassarini-Jacobs, 1993). It is composed of the steps of assessment, planning, intervention, and evaluation. One of the salient features of the formal nursing process is its linear and sequential nature, and it is usually taught in this manner. A recent nursing text emphasizes:

At first, the nursing student must learn to use the nursing process systematically -- one step at a time. Then, with experience, the student can combine the nursing process steps, integrating thought and actions for all steps. (Morton, 1993, p. 4)

However, some authors are finding that in practice the various phases are overlapping and concurrent (Miller & Malcolm, 1990). The health status of patients often changes rapidly and the nursing assessment has to be an iterative on-going process throughout the nurse-patient interaction. Experienced nurses know this and act accordingly. They focus on the patient's most urgent problems, vaulting over secondary data collection and responding in a manner appropriate to the patient's physical symptoms, mental and emotional state, and social context. Students witness the intervention and are bewildered, as they see only the results and have no clue as to the underlying thinking processes that have prompted such action by the nurse. When

they attempt to imitate the professional's example, they have no basis for their judgements and run a high risk of committing serious mistakes. The causal link between assessment and action has been lost to their view.

6. Physical Assessment and Thinking Skills

It is apparent that instruction in patient assessment needs to include more than just the physical evaluation criteria. It should also convey the requisite cognitive processes by which the data is perceived, identified, analyzed, prioritized, and used. Addressing explicitly the thinking steps involved (Rogoff, 1990) would elucidate the expert thinking for the novices, an act which would make the instruction more useful for the students and the clinical practice safer for the patients.

This researcher's analysis of nursing students' common problems with physical assessment shows that they struggle to manipulate the abstract propositions involved. When they enter the course they have had some experience in collecting data, but as they acquire increasing domain knowledge they are expected to choose pertinent data and prioritize it. For example, the students should recognize that spasmodic breathing in a newborn is normal but that in a child receiving morphine it constitutes a crisis. Identifying critical elements and relations is not explicitly taught in earlier courses. Thus an important learning at the second year level is to determine connections between data. For instance, if a patient passes a scant amount of dark urine, the student must compare the voided amount to the expected output for the patient's size, must compare its appearance to normal amber colour, must measure its specific gravity and contrast it to the usual values, then realize that the patient's fluid balance may be impaired. Hence they need to draw conclusions and make sound inferences, thinking through the implications of the data in order to formulate a hypothesis as a basis for reasoning. The nursing plans have to be elaborated in detail and the course of action clearly worked out, such as what quantity and types of fluids to administer to the patient and by which routes. Finally, the students are expected to re-assess the patient and compare actual outcomes to desired ones, to verify and critically examine the effectiveness of their nursing actions.

Nursing educators have become aware of the need to address students' thinking skills, and numerous modifications to traditional teaching emphases are currently underway. Some nursing texts focus on problem solving (Ladewig, London, & Olds, 1994), defined as an application of the scientific method for identification and resolution of health care issues. Others centre around critical thinking (Alfaro, 1995; Rubenfeld & Scheffer, 1995), described by Watson and Glaser (1964) as an attitude of inquiry, supported by a knowledge base and enhanced by skill in application. This definition was expanded by Richard Paul (1992) to include "the art of thinking about your thinking while you are thinking in order to make your thinking better" (p. 643). Improved thinking skills are expected to translate into better planning of action and improved practice. Until now the applications of these advances have tended to cluster in the areas of nursing interventions (Pillitteri, 1995) and the writing of care plans: "The written nursing care plan allows the instructor to analyze the students' thoughts and offer alternatives" (Black & Matassarini-Jacob, 1993, p. 5). However, the format for physical assessment remains an exhaustive list of abnormalities the student should look for using the classic examination techniques. The usual instructional approach is to point out what information is to be obtained and then to evaluate the student's written assessment report for thoroughness in presenting the data (Dawson College, 1996/97).

Non-nursing educational research, however, has gone much further. In the 1980's, courses in thinking skills, under labels such as strategic, critical, lateral, or cognitively-enhanced thinking, were widely disseminated (Rosenzweig, 1992). Since then, the focus has moved beyond teaching thinking skills in isolation to situating them in authentic contexts of practice (Jonassen, 1994). This evolution can be seen in the educational psychology literature, and its relevance to teaching physical assessment is reviewed in the second chapter of this report.

7. Physical Assessment and Cognitive Apprenticeship

The nursing literature does not appear to critically analyze the basic way in which the nursing instructor traditionally conveys the theoretical and heuristic skills of physical assessment, namely to focus on the data to be obtained. A different approach becomes possible

if one considers the theory of cognitive apprenticeship. According to this concept, just as motor skills can be taught by example, so also the expert's thinking skills can be taught by making them accessible to the novice (Rogoff, 1990). A full description of this theory is presented in the literature review section; in brief, "cognitive apprenticeship provides access to knowledge normally held tacitly about how to perform in the real world" (Brandt, Farmer, & Buckmaster, 1993, p. 75). Once the teacher's cognitive processes are exposed, students can observe, enact, and practice them with help from the teacher and from other students.

8. Physical Assessment and Think-Aloud

In order for the teacher's thinking processes to become available to the learner, they need to be verbalized and communicated (Collins, Brown, & Newman, 1989). One of the ways in which this can be achieved is called think-aloud. Think-aloud methods have been defined as those which "require subjects to provide reports of the ongoing thoughts, images, and feelings they are experiencing" (Genest & Turk, 1981, p. 236). Authors in the cognitive apprenticeship field use both the terms "think aloud" and "talk aloud" in referring to the concurrent verbalization of task-relevant information to which a subject attends while doing a task. Ericsson and Simon (1993) make a distinction between the two cognitive processes, based on the amount of intermediate processing required. For these authors, "talk aloud" refers to the subjects uttering that which they are saying silently to themselves, i.e. thoughts which are already encoded in verbal form. In contrast, "think aloud" refers to uttering all kinds of thoughts, orally encoded or not, such as visual imagery, and whether perceived, generated through cognitive processes, available in short-term memory or retrieved from long-term memory. In performing physical assessment, the teacher and students verbalized multi-sensory data collection, complex analyses of information, and introspection, thus the range of thoughts articulated involved the more complex processing level. Therefore the term "think aloud" is considered appropriate for the action, and "think-aloud" for the pedagogical method. "Talk-aloud" was used infrequently but will appear in a few of the quotations from participants; it should be considered interchangeable with "think-aloud" for the purposes of this research project.

Thinking out loud while performing a physical assessment reveals the assessing person's observations, analyses, and formulation of plans for nursing intervention. It also lays bare the questions, uncertainties, and knowledge gaps encountered, as well as the manner in which these are thought about. The teacher's verbalizations provide a model, and when students think out loud the teacher can identify areas of mastery and areas in which they need assistance. In this way, the learning environment becomes one of support and guidance, as the instruction becomes tailored to the individual student's needs and serves as an apprenticeship in thinking.

9. The Research Problem

Advances in educational psychology have encouraged the use of situated learning approaches, and clinical instruction in nursing has always had a strongly contextualized component. However, the traditional pedagogy for physical assessment has focused on factual content rather than on the thinking skills required for this crucial professional activity.

Therefore, this project consisted of the development and implementation of a think-aloud method based on cognitive apprenticeship theory. The research objectives were a) to identify if and to what extent the use of think-aloud, in the clinical context of the Dawson College course on Maternal-Child Nursing, contributes to the creation of a positive learning environment as depicted by Collins, Brown, and Newman (1989), and b) to utilise the data collected from the target population in order to translate into concrete situations the different characteristics of the frame of reference. Above all, the researcher's aim was to understand and describe in a qualitative manner the use of think-aloud in teaching physical assessment to nursing students.

CHAPTER II

REVIEW OF THE LITERATURE

In this project, think-aloud is situated within the parameters of cognitive apprenticeship, a constructivist concept built on situated learning theory. In order to fully present think-aloud, it is necessary to examine these concepts in relationship to each other and to this project. Segmenting the discussion is awkward, as the concepts are closely interrelated. Nevertheless, constructivism, situated learning, and cognitive apprenticeship will each be discussed. Then the role of two other considerations important to think-aloud will be examined: language and perception.

1. Constructivism

Think-aloud depends on active participation by the students and their engagement in building their own understanding of the subject. Designing the teaching of physical assessment in such a way as to enhance this process requires an understanding of the constructivist interpretation of learning. While much of the refinement of this principle has occurred in the second half of this century, its roots can be traced significantly further back. The antecedents of constructivism are presented here, followed by their development into experiential learning. The most relevant current interpretations of constructivism are summarized.

1.1 Antecedents of Constructivism

For Socrates (cited in Phillips, 1995), knowledge was the result of a learner's activity rather than of the passive reception of information. Wineburg (1989) points out that educational theorizing about the relationship between knowing and doing is a tradition that goes back to Aristotle's formulations of moral behaviour in the *Ethics*. Phillips (1995) adds that "the complex epistemology of Immanuel Kant was quintessentially constructivist" (p. 6). Kant distinguished between phenomena (things as known) and noumena (things in themselves), stating that knowledge is a joint product of mind and external world arising in experience, and concluded:

"We only know phenomena" (Castell, 1963, p. 212). Pointing out that the term constructivism originated with eighteenth century philosopher Giambattista Vico, Gruender (1996) summarizes:

Educational constructivism, along with the various forms of idealism offered by Berkeley, the critical idealism of Kant, and some of the idealistic views that have appeared since Kant, including early positivism, are animated by the powerful recognition that knowledge begins with individuals, and that an enormous amount of human constructive effort goes into its creation. That is the important insight which constructivist philosophies serve to remind us of, and whose implications for education are numerous and important. (p. 23)

In 1807, Hegel argued for a necessary relationship between the activity of human labour and the growth of self-knowledge: "by working on and transforming nature, by imposing his own designs upon matter, man comes to be surrounded by a world which embodies his self-assertion as a 'subject'" (Hegel, 1966/1807, p. 40). A cornerstone of his philosophical system was action not only for one's own needs or instincts but also in relation to an idea, a nonbiological end. Hegel termed this process *Vermittlung* (mediation), linking work to the emergence of human consciousness and self-consciousness, thereby setting the stage for the development of concepts of mediated learning in socio-cognitive theory through Marx to Vygotsky and Feuerstein (Presseisen & Kozulin, 1992).

Marx (1978/1845) insisted that people can only be understood in a historical and cultural context, as agents acting in relation to each other and to other communities. In his *Theses on Feuerbach* (1978/1845), he contended that the essence of man is no abstraction inherent in a single individual, but rather the ensemble of the social relations. Vygotsky (1981) in effect was re-stating Marx when he wrote that "humans' psychological nature represents the aggregate of internalized social relations that have become functions for the individual and form the individual's structure" (p. 164).

1.2 Experiential Learning

Think-aloud as practised in this project takes place in the college nursing laboratories and above all at the patient's bedside in the hospital. "While contextual learning is as old as human learning, its application to classrooms in the U.S. was first proposed by Dewey, the

progressive educator and philosopher" (Weinbaum & Rogers, 1995, p. 3). Dewey's laboratory school at the University of Chicago, established in 1896, embodied many of the principles of contextual learning, especially the relation between actual experience and education. He reacted against the rigid, rote curricula of his day, emphasising instead student self-pacing, practical hands-on activities, genuine interest, and cooperative discourse (Dewey, 1902). He promoted active learning, stating that "all genuine education comes about through experience" (Dewey, 1938, p. 25). Gardner (1991) regards Dewey's educational philosophy as absolutely central to current reforms, arguing that Dewey's approach fits well with the cognitive apprenticeship genre of learning. Prawat (1995) praises Dewey's nondualist pedagogical and philosophical views:

Dewey's ontological solution to the mind-world problem, a triangular relationship between individual, community, and world mediated by socially constructed ideas, represents a compelling alternative to what passes for current constructivist practice. (p. 14)

Similar to the philosopher William James, Dewey stressed the importance of verification and qualitative confirmation; "for Dewey and other pragmatists, society provides the reference point for making sense out of an indeterminate world" (Prawat, p. 18). While Dewey's concept of "knowledge-in-use" identifies education as growth based on experience (Leahy & Corcoran, 1996), for him this was a process occurring solely within the individual.

1.3 Interpretations of Constructivism

This researcher based the think-aloud project on the principle that the process of learning occurs as the student ascribes meaning to information or experience. This is clearly a constructivist approach, according to Duffy & Jonassen (1991):

Constructivism provides an alternative epistemological base to the objectivist tradition. Constructivism, like objectivism, holds that there is a real world that we experience. However, the argument is that meaning is imposed on the world by us, rather than existing in the world independently of us. There are many ways to structure the world and there are many meanings or perspectives for any event or concept. Thus there is not a correct meaning that we are striving for. Meaning is seen as rooted in, and *indexed* by, experience. (p. 8)

Much of the constructivist framework is built on the tenets of cognitive psychology developed by Piaget (1926) in the first half of the twentieth century. His central concern was to understand the process by which humans construct their knowledge of the world:

In broad terms, Piaget postulated the existence of cognitive schemes that are formed and developed through the coordination and internalization of a person's actions on objects in the world. These schemes evolve as a result of a process of adaptation to more complex experiences (equilibration). New schemes thus come into being by modifying old ones. (Driver, Asoko, Leach, Mortimer, & Scott, 1994, p. 6)

Piaget (as cited in Flavell, 1963) formulated it as follows: "an act of intelligence in which assimilation and accommodation are in balance or equilibrium constitutes an intellectual *adaptation*" (p. 47). Flavell summarizes two fundamental principles:

1. The Piagetian dictum: "Penser, c'est opérer" (p. 367). Stable and enduring cognitions about the world can come about only through interaction with the world. The student must be led to perform real actions on the materials which form the learning base, actions as concrete and direct as the materials can be made to allow. As they are repeated, they become schematic and internalized so that originally overt actions are gradually transformed into mental operations.
2. The paramount importance of interactions with peers: to learn the meaning of perspective, one must pit one's thoughts against those of others, noting similarities and differences. "Social cooperation is thus one of the principal formative agents in the spontaneous genesis of child thought" (p. 369).

Rogoff (1990) broadens the child-centred focus to include any learner, pointing out that transformations in thinking occur throughout the life span. She criticizes Piaget's assumption that cognitive activities are general across contexts and require no consideration of the specifics of a problem. Studies conducted in the 1980's brought increased recognition that cognitive processes differ according to the domain of thinking and the specifics of the task content involved. Rogoff's (1990) conclusion is that "a broader view of cognition and context requires that task characteristics and cognitive performance be considered in the light of the goal of the activity and its interpersonal and sociocultural context" (p. 6).

This view questions the relevance of an epistemological distinction between what is in the head and what is in the world, preferring the non-dualistic approach which "considers that human activity and the world are mutually constitutive" (Bereiter, 1994, p. 26). DeFalco (1995) affirms that the mind changes what it knows in the act of knowing it. This position "eliminates any dualisms and recognizes that the mind and the environment are interdependent, that reality cannot be perceived apart from experience, and the universe cannot be separated into the real and the ideal" (p. 59). He holds a pragmatic position on knowledge, viewing it as being "created by the dialectic of the student with the text or the experience: the meaning emerges from the interaction" (p. 60).

Cobb (1995) distinguishes between Piaget's psychological constructivism, in which meaning is in the individual's mind, and interactionist constructivism which he terms the joint approach, in which individual reorganization occurs as a person participates in social practices. Bereiter (1994) judges that constructivism

has evolved from its Piagetian origins in a way that more and more addresses problems of academic learning. The Piagetian concern with underlying cognitive structures has not been abandoned. However, whereas earlier Piagetian educators saw the acquisition of such structures and the learning of cultural conventions as discrete, perhaps even representing different cognitive processes, there is now a fine appreciation of how profoundly the taken-as-given concepts, symbols, and conventions of scientific and mathematical communities shape the cognitive structures that develop (a very Vygotskian idea). (p. 21)

2. Situated Learning

This research project employed think-aloud in the actual settings of pediatric and obstetric nursing in acute care hospitals, as opposed to offering the same content in a theoretical course on general patient assessment. This format, dictated by the college curriculum, effectively met the criterion of situated learning that "whenever possible, learning should occur within the context of a given situation and should attempt to replicate as closely as possible practices used by experts in a given culture" (Evanciew, 1994, p. 6). In this section the basic theories of situated learning are described, along with a discussion of mediated learning and social cognition.

2.1 Theories of Situated Learning

Wilson (1993) points out that in the theory of situated learning, experience becomes activity and takes on a dynamic relation to learning. People no longer learn from experience, they learn in it, as they act in situations and are acted upon by situations. He concludes:

If the significance of situation is given prominence, then our practice as educators must surely change. Once located in their naturally occurring settings, knowing and learning become intricately integrated with the tools, social interaction, and activity of their use. It is there that we must concentrate our energies and insights as educators by sorting out what is truly transferable from what is situationally specific. (p. 78-9)

Streibel (1994) agrees that knowledge and action are in a dialectical relation: "facts are theory-laden and theories are only substantial when they are imbued with facts" (p. 15). She clarifies that the situated learning paradigm presumes that the meaning-making processes of an individual operate within the context of the social construction of knowledge of discourse communities.

Maiorana (1992) asserts that the teaching of critical thinking skills must be integrated with subject matter instruction, and Rogoff (1990) maintains that thinking is intricately interwoven with the context of the problem to be solved. She defines *context* as the problem's physical and conceptual structure as well as the purpose of the activity and the social milieu in which it is embedded. Learning is a recursive process in which people act in and interact with context; "context is an integral aspect of cognitive events, not a nuisance variable" (Rogoff, 1984, p. 3). As Choi and Hannafin (1995) point out, decontextualized and simplified knowledge fosters understanding that is rigid, incomplete, and naive. In contrast, when people learn new information in the context of meaningful activities, they are more likely to perceive the new information as a tool rather than as an arbitrary set of procedures or facts (The Cognition and Technology Group at Vanderbilt, 1990). In evaluating learning that occurs in the workplace, Lankard (1995) adds that situated learning provides the opportunity for workers to clarify their understanding within the social context and reduce the incidence of misinterpretation and faulty learning.

Young (1993) stipulates that to meet the test of "authenticity," situations must have some of the important attributes of real-life problem-solving. These include ill-structured complex goals, an opportunity for the detection of relevant versus irrelevant information, active/generative engagement in finding and defining problems and solving them, involvement of the student's beliefs and values, and an opportunity to engage in collaborative interpersonal activities (p. 45).

The cardinal benefits of situated learning are summarized by Collins (1988) as consisting of students learning the conditions for applying knowledge and seeing the implications of the knowledge, and the context fostering invention and structuring knowledge appropriate to its uses. Further advantages identified by Damarin (1994) include the obliteration of the status distinction between school-based and life-based knowledge, as conceptually there is an egalitarian aspect to situated cognition. Visuality and other nonverbal sensory modes of knowledge acquisition and deployment are recognized more fully in situated learning than in other theories, and Damarin depicts the sharp divisions between cognitive, affective, and psychomotor domains as softened and even eliminated in situated learning, since they are often deeply entailed in each other.

As Levine, Resnick, and Higgins (1993) explain, "in the messy 'real world' it is difficult to imagine any situation that is purely cognitive -- devoid of emotions, social meanings, social intentions, and social residues in the form of inherited roles and tools" (p. 604). McLellan (1993a) asserts that "the promise of enhancing learners' ability to learn makes situated learning worthy of continued dialogue and exploration" (p. 8).

Hewson (1989) studied medical education and found that students construct knowledge in ways that are to them coherent and useful, but that the construction process is influenced by a variety of common social experiences. Thus the knowledge constructed by each individual is not completely personal or idiosyncratic. He suggests that meaningful learning changes conceptual structures: "learning involves an interaction between new and existing conceptions with the outcome being dependent on the nature of the interaction" (p. 8). This view counters relativism and von Glasersfeld's (1996) stance that "whatever things we know, we know only insofar as

we have constructed them as relatively viable permanent entities in our conceptual world" (p. 19), affirming instead the centrality of shared experience.

2.2 Mediated Learning

The constructivist view of learning does not delimit a specific function for the teacher, but in think-aloud the teacher plays a crucial role. This is based on the concept of mediated learning, which stipulates the key task of the teacher in assisting students' knowledge construction (Feuerstein, 1978, 1980). Having worked closely with Piaget, Feuerstein addresses the question of learning by examining its component factors and processes. In light of Piaget's model of cognitive development, he describes the human mind as "autoplastic", in an on-going process of change. To Feuerstein, learning is the ability to take bits of information and make sense of them, to modify oneself by manipulating them; one learns not by being modified but by becoming increasingly modifiable.

Feuerstein (1980) emphasizes that the knowledge of how to adapt and change, how to identify unchanging reference points and how to give meaning to events, is passed within a culture from one generation to the next. Factors which disrupt the process, such as cultural discontinuity, numbing poverty or narrow exposures, cause a deficit in the affected person's cognitive abilities. Through this perception of intelligence developing in the social process of teaching and learning, Feuerstein enlarged Piaget's stimulus-organism-interaction model to include a role for the teacher, the human mediator who interprets both the environmental stimulus and the person's response to it. He called it a "mediated learning experience" (MLE) and outlined its main characteristics that differentiate it from other interactions.

In MLE, it is essential that there be intentionality: the mediator purposefully comes between the person and the objects or events in the environment in order to change the learner's cognitive structure. When the immediate needs of the task are met, the mediator leads the learner to articulate the skill learned, abstract the principle involved, generalize it, and then apply it in a variety of situations. This transcendence creates insight as well as stimulating curiosity and a hunger for further learning. The mediator also guides the learner in attributing

meaning to the event, explaining the value of the learning. The reflection involved in this leads learners to seek meaning and engage in their own evaluation process.

In steps that parallel the physical assessment process, Feuerstein (1980) identified that cognitive functions occur in three stages: input (gathering the information), elaboration (using mental operations to think about it) and output (expressing the result). To promote these skills he created a program of "Instrumental Enrichment", a series of problem-solving exercises which are grouped in areas of specific cognitive domains rather than according to subject matter. Of particular importance to the concept of think-aloud is his view that "it is the teacher who leads the way in moving from the realm of the immediate task to the abstract and orients the students in their search for understanding and application" (p. 301).

Feuerstein's (1978) instrument designed to foster analytic perception points out that "the common element in all analysis is the breakdown of a whole into its parts and the establishment of relationships between the whole and its parts, and between the parts to each other" (p. 2). Cognitive restructuring of the perceptual field requires disembedding, closure, decentration, and hypothesis testing; in physical assessment this would mean recognizing abnormal data, specifying what data is missing, distinguishing between objective and subjective data, and checking for symptoms of expected consequences of the patient's problem. In a medical text on physical assessment, Bates (1974) cautions that "while learning new skills, the beginning practitioner may lose his perspective and become temporarily confused by the wealth of detail" (p. 1). Addressing this common problem, Feuerstein (1980) contends that adequate cognitive functioning depends on maintaining a balance between differentiation and integration.

Feuerstein (1978) urges that "the student must be able to see the application of what he learns in the instrument to real-life situations and subject matter areas" (p. 3). But B. Smith (1987) goes further, contending that "it cannot be overemphasized that the teaching of thinking does not take place by working directly with mental processes. It is the way teachers work with the content of instruction that affects the way students learn to think effectively" (p. 39). Presseisen and Kozulin (1992) would reply that it is mediation that provides the link between thinking processes and subject content; "mediated learning legitimizes thinking" (p. 33). As they reiterate, mediation stresses pliable, dynamic intelligence rather than inert knowledge with its

corollary of passive learning. A communal understanding of knowledge helps the learner to frame and filter the stimuli; as these authors state,

mediation is concerned with going beyond the information given, with connecting the present with both the past and the anticipation of the future. Thus it is a new paradigm for education.... Intelligence as the ability to learn and change. (p. 7)

Like Dewey, Feuerstein (1980) proposed a learner-centred orientation to curriculum and instruction, addressing students' needs and abilities as a central part of planning effective teaching. Booker (1984) adds that "mediation requires continuous teacher/student interactions, varied materials and methods of presentation, carefully sequenced tasks and much non-judgemental, non-product-oriented but process-observable practice" (p. 16). In a proposal of apprenticeship as a paradigm for learning, Berryman (1992) says that significant learning characteristically takes place in context, guided by mediators such as parents, peers, or teachers. She sees mediated learning as typified by useful problem-solving with a goal and involving an explicit statement of need and purpose. Resnick (1987) affirms that social communities play a key role in developing thinking skills, and that the disposition to possess and use skills and knowledge is part of learning; she calls apprenticeships powerful frameworks for mediated learning. Mediated learning thus fundamentally assumes the social nature of cognitive processes and of the learning environment.

2.3 Social Cognition

Think-aloud as developed in this project involves a social setting and numerous individuals: the student, the patient, the teacher, and student peers within the clinical group. The structure of interactions between them is of significance in light of Vygotsky's view of learning. Rejecting Piaget's epistemological individualism, his contemporary Vygotsky (1962/1934, 1978/1933, 1981, 1987) made Marxist philosophy the basis of his educational theory, particularly the assertion that an individual's cognitive functioning can only be understood by analyzing the social foundations from which it emerges. Laying the foundation for learning strategies in cognitive apprenticeship, he coined the term "zone of proximal development" to demarcate

the distance between the actual developmental level of the child as determined by independent problem solving, and the level of potential development as determined through problem solving under adult guidance or in collaboration with a more capable peer. (Vygotsky, 1978/1933, p. 86)

Palincsar and Brown (1984) note that in traditional terms these are notions of readiness, and that "what is distinct about Vygotsky's theory is the important role attributed to the social context and expert scaffolding" (p. 123). The child-adult interaction is also expanded to any learner-teacher dialogue. Schön (1987) gives an example of the zone of proximal development in his anecdote of a teacher asking an architecture student how he will mark the difference in levels, when the student has not yet noticed the irregularity of the slope. Perkins and Blythe (1994) propound that the mainstay of "learning for understanding" must be actual engagement in performances which "take students beyond what they already know" (p. 6). Applying this principle, Hamilton and Hamilton (1992) describe:

In our observations of apprentices, we have observed many repetitions of a cycle that embodies Vygotsky's idea of the zone of proximal development: apprentices begin by *observing* a coach perform a task, then begin to *assist* with the task, and finally are able to *perform* the task themselves. Sometimes the cycle applies to a complex and difficult task that takes months to master. Other times it is completed for a simple task in a period of minutes or hours. Hence, learning a complex task can comprehend a long series of cycles within cycles. (p. 21)

Linked to Vygotsky's view of learning is the concept of cultural mediators, by which he meant socially developed instruments classified as psychological tools, material/technical tools and other human beings (cited in Wozniak, 1980). Vygotsky specified that students' participation in activities with more skilled partners allows them to internalize the tools for thinking. Comparable to Feuerstein, he deemed that "the meaning of one's own activity is thus formed by mediation through another individual.... One may say that only through the other do we become ourselves" (Vygotsky, 1978/1933, p. 144). He portrayed the development of thought as occurring in two stages: first on the social "interpsychological" plane between people, then within the individual on an "intrapyschological" plane. Thus even in internal mental processes, the functions of social interactions are retained (Vygotsky, 1981). Importantly, this internalization is not a passive process; like Piaget and Dewey, he recognized the active constructive role of the child or student. "Children *reorganize* and *reconstruct*

experiences of their physical and social environment. The mental plane is not isomorphic with the external plane of action and speech; as the external plane is internalized, transformations in structure and function occur" (cited in Driver & Scott, 1995, p. 28). In short, as Davydov (1995) confirms, a Vygotskian perspective does not separate individual cognition from its sociocultural origins. Rather, as stated by Welker (1992), "knowledge is socially constructed and linked to human intentionality and behaviour" (p. 118).

Not all constructivist theorists agree with this approach, however. Hüberman (1993) proposes a "canonical model of cognitive restructuring" (p. 389) from a purportedly constructivist point of view, but simply reiterates Piagetian concepts of cognitive conflict without acknowledging the social factors involved. This indicates that constructivism can take differing forms, not all of which are in accord with this research project's sociocultural approach. Indeed, E. Smith (1995) delineates a distinction between *knowing* (the individual subjective meaning) and *knowledge* (the socially negotiated form). Cobb (1994) claims that "each of the two perspectives, the sociocultural and the constructivist, tells half of a good story, and each can be used to complement the other" (p. 17).

To this division, Driver and Scott (1995) respond that "it is particularly important to adopt a perspective that embraces both positions" (p. 28). Ickes and Gonzalez (1996) note that "the field of social cognition includes two Kuhnian paradigms that differ substantially in their assumptions about what the core phenomena of social cognition are and how they should be studied" (p. 304). They explain that the one is focused on the single individual, whereas the other views social cognition as the subjective reactions of at least two individuals to their interaction experience and as the shared, intersubjective meaning that they jointly construct through their interaction behaviour. The position of cognitive apprenticeship is summarized by Brown, Collins and Duguid (1989):

A theory of situated cognition suggests that activity and perception are importantly and epistemologically prior to conceptualization.... A new epistemology might hold the key to a dramatic improvement in learning and a completely new perspective on education. (p. 41)

3. Language

The principal feature of think-aloud is the role ascribed to verbal articulation in forming patterns of thinking. Spoken language was central to this research project. Vygotsky (1981) emphasized the role of language, although his list of tools for semiotic mediation also included counting systems, algebraic symbols, works of art, writing, schemes, diagrams, maps, and drawing. "By being included in the process of behaviour, the psychological tool alters the entire flow and structure of mental functions" (p. 137). He went further, arguing that not only are tools the products of sociocultural evolution and are situated in a sociocultural context, but also by their nature they are social, not organic or individual.

In stark contrast to Piaget's view of speech originating from an egocentric basis (Das, Kirby, & Jarman, 1979), Vygotsky (1962) contended that thought development is determined by linguistic tools and sociocultural experience, and he delineated a continuum from social speech which is aloud to others, to private speech vocalized aloud to oneself, to inner speech which is silent. Internalized speech thus becomes a system of tools for the manipulation of thoughts. This is reflected in the words of Mead (1969/1934), who wrote that "the internalization in our experience of the external conversations of gestures which we carry on with other individuals in the social process is the essence of thinking" (p. 159).

In this project, students commented that their thinking out loud during physical assessments eventually took the form of silent speaking to themselves. Smolucha (1992) notes that in psychotherapeutic interactions "social speech becomes internalized as self-regulating inner speech" (p. 9). Similarly, Meichenbaum (1977) has explored the modification of thinking patterns through articulation, promoting the use of self-talk in order to change behaviour. However, Bakhtin (1986) insists that all speech is dialogical. Of relevance to nursing education, he describes the characteristic social languages developed by different professions, and stresses that mastering these is not just an interpsychological but also a sociocultural process.

Many constructivists support Vygotsky's view of the importance of language as a mediator of meaning, but its role continues to be debated. Marzano *et al.* (1988) affirm that "concept knowledge and word knowledge seem inexorably linked in the thought and language of

a given culture.... We do not fully possess a concept until we have a label for it" (p. 35). This position follows linguists such as Whorf (1956), who assert that language shapes perception. Piaget and Chomsky (1968) have held famous debates about innateness and genetic programming of grammar, but the constraints of this research report prevent a detailed presentation of the on-going controversy regarding the relationship between speech and thought. For example, Pinker (1994) views language as an evolutionary instinct, and Tripp (1993) derisively pronounces that "the Whorfian hypothesis has been widely disconfirmed and abandoned" (p. 74). For the purposes of the project, this researcher adheres to the Vygotskian analysis of speech as a social tool for cognitive functions.

According to Wertsch (1980), two concepts underlie Vygotsky's views on language, namely that a) both qualitative and quantitative changes are defined in terms of mediation, and b) mediation provides the key to formulating the link between interpsychological and intrapsychological functioning.

Wertsch (1985) introduced the term "intersubjectivity" (p. 161) to denote the process of establishing an initial task definition between teacher and student, a verbalization which he saw as basic in creating a learning environment and a crucial step in the transition from interpersonal to individual functioning. The specific factors which he identified as aiding this transition are of direct relevance to think-aloud:

1. Cognitive readiness (Vygotsky's zone of proximal development);
2. Willingness by the teacher to transfer responsibility to the student;
3. The teacher's use of reflective assessments as feedback;
4. The explicitness of the teacher's directives;
5. Construction of a joint definition of the task.

Interestingly, Rogoff (1990) makes a point of including nonverbal communication, studying extensively the cultural tools of early childhood "before speech becomes intellectual and thinking verbal" (Vygotsky, 1987, p. 110). But for older children and students Rogoff (1990) emphasises spoken language. Referring to Vygotsky's "motivating sphere of consciousness" (p. 9) she affirms that thinking is the attempt to determine intelligent means to

reach goals, which in human society always involve other people and carry feelings with them. Influences of Dewey and Marx can be recognized in Rogoff's view:

Information and skills are not transmitted but are transformed in the process of appropriation. Social activity serves not as a template for individual participation but as a stepping stone, guiding the path taken but not determining it.... Just as the meaning of conversation depends on both the information offered by the speaker and the interpretation by the listener, processes of guided participation depend on the structure provided by social activity and on its appropriation by the individual. (p. 197)

4. Perception

The content of the student's articulation in this project is the data being collected about the patient's physical status. An implicit prerequisite is the student's perception of the presence of patient attributes to be considered. The words of Cornforth (1977) apply:

To think about the world we must first perceive the world.... Thinking, then, grows out of perception. And this development takes place only in and through the active relationship to the external world which men establish for themselves in the course of their practical social activity. Perception itself is not just a passive receiving of impressions from external objects. The development of sensation into perception is the product of the development of active relationships to the external world. (p. 36)

One of the most commonly heard exclamations of exasperation among nursing instructors is that students "just don't see" their patients' problems. Heil (1983) discusses the senses and neural pathways involved in perception, pointing out that information is "a feature of a mode of stimulation; it may be picked up, or overlooked or ignored altogether" (p. 11). The author places information in the world, not in the perceiver, saying that "language can be used to depict the world only if the world has independent structure, a definite character to be depicted" (p. 112). He lists physiological factors, external conditions, and cognitive factors as influences on perceptual capacities. Correspondingly in nursing, sensory limitations are only partially offset by the use of instruments such as stethoscopes; assessment variables of distance, light, and position affect the data obtained; and the examiner's knowledge about what is perceived shapes its interpretation.

It is the cognitive dimension which distinguishes the categories of sensation and perception. Perception involves more than a simple, unstructured reaction to stimuli -- it must include the application of concepts (Heil, 1983). Gruender (1996) adds that sensations and awareness occupy only the temporal present, whereas all knowing which goes beyond the present requires the mediation of structures, concepts, or constructs which are internal. "It is reasonable to call them "constructs" because each of us, along with every cognizing creature, has to construct them ourselves" (p. 25).

A recent nursing textbook by LeMone and Burke (1996) classifies data as being either objective or subjective, without indicating any subtleties in the nurse's process of perception:

Information that the nurse perceives by the senses is objective data; it is seen, heard, touched, or smelled, and can be verified by another person -- for example, blood pressure, temperature, pulse, or the presence of infected drainage. Information that is perceived only by the person experiencing it -- for example, pain, dizziness, or anxiety -- is subjective data. (p. 8)

In contrast, Heil (1983) estimates that due to differences in people's constructs and forms of knowledge, "what one creature can apprehend directly may require, for another, a lengthy chain of inferences" (p. 44), and he gives the example of different perceptions of the same stimulus:

You and I watch the antics of a bird in the garden. My impression is of a smallish brown bird flying about distractedly. You, in contrast, see a crested warbler stalking worms.... This need not mean that we are aware of distinct "perceptual objects". It is just that you, because you know rather more than I do about birds, are able to see **more** than I can see. (p. 55 & 58)

In such a case it is pointless to look more closely or to focus one's attention in a certain way; to see more fully one must possess more knowledge. Costa and Marzano (1987) agree, stressing the linguistic element in perception. They give an example of looking at a night sky and seeing only stars, then after an astronomy course looking at the same sky and seeing super novae, white dwarfs, and galaxies; "new labels foster new perceptions" (p. 30). Metacognitive control enters into the picture, as full perception is described as: "I not only take account of my

surroundings, but recognize as well my taking account of them" (Heil, 1983, p. 106). As Dewey (1974) wrote, the student

has to see on his own behalf and in his own way the relations between means and methods employed and results achieved. Nobody else can see for him, and he can't see just by being "told," although the right kind of telling may guide his seeing and thus help him see what he needs to see. (p. 151)

Heil (1983) cautions that cases in which information is passed over because of a cognitive error must be distinguished from those in which the deficit is itself purely informational, and he creates a perceptual error taxonomy differentiating subjective errors (due to conditions attributable to the perceiver, such as cognitive mistakes) from objective errors (due to external conditions, such as optical illusions). However, he advises avoiding a passive view of perception; rather than trying to account for deletion of information, one should focus on its selective acquisition, a skillful activity engaged in with purpose and intent. "You and I converse all morning, yet I may fail to notice what color shirt you are wearing. I saw it, surely. Yet I find that I have no beliefs at all about its color" (p. 71). There are no sharp demarcations between categories of things attended to fully, marginally, or not at all; since there is far more information available than can reasonably be picked up, one ignores or filters out much that on other occasions might register. He surmises that motivational factors play a role, suppressing perception when it is not seen to be in one's interest. The implications of this for teaching physical assessment are enormous, as it means that students need to not only expand their conceptual repertoires but also modify their attitudes commensurate to their acquisition of knowledge.

Bromme and Tillema (1995) concur, commenting that professional knowledge is not just represented mentally as rules. "The cognitive set of tools necessary for successful professional practice also includes images, metaphors and attitudes. One could even argue that orientations and beliefs play the more prominent role" (p. 263). Thus, Marzano *et al.* (1988) declare that "it is virtually impossible to view the world neutrally. The assumptions we make, even the instruments we use, shape the information we perceive" (p. 126). This view of content-area knowledge implies that the individual is organically linked to the content, which itself is fluid and changing.

Curriculum and instruction must take into account not only the learners' prior knowledge, but also the academic and social contexts they are likely to experience in the future. These authors submit that as with many thinking skills, a major portion of learning how to observe is domain-specific. Accordingly, it is helpful to embed observation activities in content-area instruction, sequencing observations from simple to complex or from familiar to unfamiliar. For example, the teacher might initially inform students about the type of information to be observed; later, students can determine the important aspects of phenomena and describe differences they perceive in specific situations. In this suggestion, Marzano *et al.* (1988) reflect Foucault's (cited in Shumway, 1989) notion of the enculturation process which fixes the newcomer's gaze:

To see something means metaphorically to perceive it as it is without bias or distortions of mere thought. But it is Foucault's point that we never "see" things in this way. The gaze is a matter of applying a language or a mathematics to the thing seen so that it is constituted by the observer in his terms. Thus the gaze suggests that knowledge forms at the intersection of seeing and speaking. (p. 58)

This opinion is amplified by Hayes (1985), who used think-aloud protocols to study the influence of task definition on perception and the differences between experts and novices. "The task definition acts like a pair of colored glasses ... I simply won't see certain kinds of difficulties" (p. 26). He found that experts are more flexible than novices in adjusting their task definition in response to specific problems detected. Marzano *et al.* (1988) add that "the ability to recognize patterns and relationships seems to be related to expertise in a variety of domains" (p. 93).

In a study of medical students' knowledge development, Boshuizen, Schmidt, Custers, and Van de Wiel (1995) found that the less obvious, more intricate stimulus configurations, especially those involving more than one sensory system, must often be picked up by students from the hospital environment. "Linked to conceptual and procedural knowledge, this perceptual learning plays an important role in the development of diagnostic and patient management proficiency" (p. 272). As Brown, Collins, and Duguid (1989) remark, "the perceptions resulting from actions are a central feature in both learning and activity" (p. 36).

5. Cognitive Apprenticeship

Griffin (1995) declares that the key proposition of situated cognition is cognitive apprenticeship. The research project of teaching physical assessment using think-aloud is based on this perspective. Therefore, the theory and characteristics of cognitive apprenticeship are presented here. Both the nature of teaching within this perspective, and more specifically the role of think-aloud within cognitive apprenticeship, are explored. The suitability of clinical nursing education for the use of cognitive apprenticeship teaching methods is described. Finally, some published applications of cognitive apprenticeship in a variety of fields are reviewed as examples.

5.1 Cognitive Apprenticeship Theory

Cognitive apprenticeship theory has been called social constructivist because it sees individuals as actively constructing knowledge and negotiating meaning as a result of social interaction (Phillips, 1995). Another term for it is sociocultural: "the basic tenet of a sociocultural approach to mind is that human mental functioning is inherently situated in social interactional, cultural, institutional, and historical context" (Wertsch, 1991, p. 86). This intersubjective approach, reminiscent of Feuerstein's (1980) view of mediated learning, became a major theme in Rogoff's (1990) model of cognitive apprenticeship: "cognitive development is an apprenticeship -- it occurs through guided participation in social activity with companions who support and stretch children's understanding of and skill in using the tools of culture" (p. vii).

A simple definition of an apprentice is an inexperienced person, a novice, who is learning by practical experience under skilled workers, a trade, art, or calling (Webster, 1984). Apprenticeships, including guild structures in the Middle Ages, traditionally were a common form of skill acquisition by novices who learned from masters, resulting in knowledge that tended to be situational, intuitive, and tacit (Leinhardt, Young, & Merriman, 1995). Apprenticeships declined when the Industrial Revolution introduced the assembly line, which required workers to perform repetitive rather than skilled tasks (Evanciew, 1994). However, numerous ethnographic studies have examined contemporary apprenticeships with traditional

structures, such as Mayan midwives learning obstetrical skills (Jordan, 1989), West African tailors learning garment production (Lave, 1991), and wood carvers learning their craft in Hong Kong (Cooper, 1980).

Common features of traditional apprenticeships are the absence of didactic instruction and the marginal involvement of the novice, whose progress is visible to the learner and to others in the process of work itself. As Lave deduces, "knowledgeable skill is part of the construction of new identities of mastery in practice" (1991, p. 64). Lave (1988) examined traditional apprenticeship formats, in particular the way in which experts perform skills and novices observe and imitate them. She found that novices move very gradually from the edges of a community of practice towards its centre, a social process dubbed legitimate peripheral participation (Lave & Wenger, 1991).

Gardner (cited in DeFalco, 1995) considers apprenticeship to be the best kind of educational experience, and he sees this exemplified in the German dual (school and workplace) system as a "paradigm for constructing true educational experiences" (p. 60). In Germany, apprenticeships are the norm for youth desiring to enter skilled trades: by participating in the workplace, novices are given challenging real-life tasks under supervision of adult experts, with the expectation of mastery before the students can advance to adult work roles (Rosenbaum, 1992). These experiences are generally part of an interrelated curriculum, in which students learn in both the work place and the school.

Adapting apprenticeship to the cognitive domain, Collins, Brown, and Newman (1989) developed a theory of cognitive apprenticeship for enculturating students into authentic practice. They maintain that conceptual and factual knowledge must be exemplified and situated in the contexts of use, and that the cognitive problem-solving processes of instructors should be externalized and made accessible to students. Recurring emphases in their model are on thinking aloud, student-teacher dialogue, and conversation amongst peers. "Cognitive emphasizes that apprenticeship techniques actually reach well beyond the physical skills usually associated with apprenticeship" (Brown, Collins, & Duguid, 1989, p. 39). According to Gredler (1992), "instruction for complex mental capabilities should begin as a shared activity between teacher and student. Then the teacher gradually transfers control to the student as he or she begins to

master different aspects of the task" (p. 288). Tharp and Gallimore (1988) name it "guided reinvention" in describing the student's transformation of what is internalized, suggesting that the term "captures aspects both of social learning and cognitive reconstructivist arguments" (p. 29).

What distinguishes cognitive from traditional apprenticeship is that the focus of learning is on cognitive and metacognitive processes rather than on physical skills (Browne & Ritchie, 1991). "Cognitive strategies are central to integrating skills and knowledge in order to accomplish meaningful tasks" (Collins, Brown, & Holum, 1993, p. 8). Analyzing the differences between traditional and cognitive apprenticeships, Collins, Hawkins, and Carver (1991) describe the ways in which teachers must adapt their practices, saying that

- a) because traditional apprenticeship teaches observable skills, teachers must try to make the process of thinking visible;
- b) because traditional apprenticeship occurs in a workplace whose products are tangible, teachers must situate abstract classroom tasks in authentic contexts that motivate students;
- c) because traditional apprenticeship teaches skills inherent in the craft, teachers must demonstrate the transfer of cognitive skills across a range of tasks.

Cognitive apprenticeship is designed to fit vocational as well as theoretical subjects; "the term 'cognitive' should not be read to mean 'academic'" (Berryman, Flaxman, & Inger, 1992, p. 3). In a study of professional knowledge, Leinhardt, Young and Merriman (1995) describe knowledge acquired in practice as being procedural, specific, and pragmatic, whereas knowledge acquired in the classroom tends to be declarative, abstract, and conceptual. They chide that university educators and researchers have ignored or devalued the uncoded knowledge of practice, as evidenced by the testing procedures which probe analytic, principled knowledge. They urge teachers to transform universal, formal, explicit knowledge for use *in situ* and vice versa.

5.2 Characteristics of Cognitive Apprenticeship

The structure and use of think-aloud in this project was designed to offer the participants a learning experience which would stimulate them to develop their physical assessment skills as fully as possible. The research design took into account the landmark article by Collins, Brown, and Newman (1989) which describes how cognitive apprenticeship creates what they term an "ideal learning environment" (p. 476, see Appendix A). They outline 18 characteristics which make the environment conducive to learning, in the four categories of sociology, sequencing, content, and methods:

1. The sociology of learning is viewed as a critical dimension of a learning environment, and the authors follow Dewey in proposing **situated learning** to give meaning to the students' tasks. The **culture of expert practice** promotes engagement in skills involved in proficiency and provides learners with models of expertise-in-use. **Intrinsic motivation** is encouraged by providing coherent goals for student activity. Peer group problem solving is a way of **exploiting cooperation** and fostering articulation of reasoning, while comparing and contrasting what students produce is part of **exploiting competition**.

2. The sequencing of instruction should be guided by principles of **increasing complexity**, **increasing diversity**, and presenting **global before local skills**. In this way the learners have an opportunity to build a conceptual model of the target skill before they are required to generate the component skills, their own activities gradually increasing in scope and difficulty.

3. The content of instruction is much broader than in traditional teaching and includes four categories of knowledge: the **domain knowledge** of a particular subject matter, the **heuristic strategies** that are effective techniques for accomplishing tasks, **control strategies** for managing problem solving and choosing tactics, and **learning strategies** for discovering and acquiring knowledge.

4. The teaching methods are the core of cognitive apprenticeship. **Modeling** involves experts carrying out tasks while verbalizing their thought processes, with students observing and listening. **Coaching** is done by the teacher observing students while they perform a task

and offering suggestions, feedback, or reminders. **Scaffolding** refers to the supports the teacher provides to help students carry out a task, such as doing parts of it cooperatively, and then gradually removing the supports. **Articulation** means getting students to verbalize their knowledge, thoughts, or problem-solving processes. **Reflection** is encouraged by discussion of the performances of both expert and novice, and comparison of the outcomes. **Exploration** forces students to frame questions and solve problems on their own, and is a natural culmination of the fading of supports.

5.3 Teaching in Cognitive Apprenticeship

The success of this project hinged on the teacher's skill in using think-aloud as a teaching method. A recurring caution about education in apprenticeship contexts pertains to the role of the teacher, as "situated learning requires the change of the teacher's role from a knowledge transmitter to a coach or facilitator of students' understanding" (Choi & Hannafin, 1995, p. 67). "In short, teachers must be in authority without being authoritarian" (Wiske, 1994, p. 21). Loughran (1994) queries whether teachers "have the courage to teach aloud as they themselves wrestle with troubling dilemmas" (p. 10). Indeed, following implementation of a cognitive apprenticeship project, the Cognition and Technology Group at Vanderbilt (1993) reported that it had "seriously underestimated the amount of time it would take for [the participants] to successfully change the culture from one of teacher as 'teller' to teacher as coach and fellow learner" (p. 64).

Designing a cognitive apprenticeship environment demands careful attention from the teacher. Merely assigning students to assess their patients would not be adequate, since "an apprenticeship setting does not of itself guarantee the development of complex mental functions" (Gredler, 1992, p. 289) and Bailey (1993) warns that "much more is required than exposing the students to the workplace" (p. 7). Weinbaum and Rogers (1995) concur:

Simply placing a student in a "real-world" context does not guarantee a learning experience, as many former interns and supervisors of internships can attest... Effective contextual learning results from a complex interaction of teaching methods, content, situation, and timing. (p. 13)

These authors state that contextual learning requires teachers to think in nontraditional ways, as instructors committed to a particular subject must consider how to teach that content through a meaningful context. "Integrating a contextual learning strategy requires instructors to undergo fundamental professional change" (p. 13).

A critique of situated learning is its potential devaluation of classroom teaching; "there is a real danger that if students are immersed in a community of practice without the support of a classroom experience, they will acquire truncated skills, and because these skills may suffice they will be fossilized" (Tripp, 1993, p. 72). Therefore, didactic instruction is still a useful adjunct to experiential learning. Anderson, Reder and Simon (1996) accede that abstract instruction can be effective, and suggest that "how tightly learning will be bound to context depends on the kind of knowledge being acquired" (p. 6). They caution that situating learning in complex social settings is not necessarily helpful, as there are component skills that must be developed before whole tasks can be attempted. However, for nursing students' clinical work, the hospital environment may be seen as Choi and Hannafin (1995) describe:

The context itself provides guidance for the activity by helping students to develop a sense of situational intent. In effect, the authentic context both cues the learner to situational resources and serves as an advance organizer for related problem-solving contexts. (p. 56)

5.4 Think-Aloud in Cognitive Apprenticeship

In a cognitive apprenticeship approach, the expert's thinking aloud "provides the beginner with access to both the overt aspects of the skill and the more hidden inner processes of thought" (Rogoff, 1990, p. 40). As Brandt, Farmer, and Buckmaster (1993) specify,

cognitive apprenticeship derives its power from knowledgeable, proficient people showing learners how to do something and stating aloud what they are thinking while doing the activity.... By asking people with real-world experience to state their thoughts aloud, much tacit knowledge is made explicit. (p. 75)

Geltner (1993) concurs that the core concept of cognitive apprenticeship is making explicit the cognitive and metacognitive processes used by experts to handle complex tasks. He adds that externalizing expert cognitive processes and situating learning in a variety of contexts

of use "helps the learner gain a fuller understanding of abstract, conceptual knowledge and establishes deep connections between such knowledge and problem-solving contexts" (p. 5). To achieve this, according to Brown, Collins and Duguid (1989), conversation and narratives must be promoted; "it is a mistake to think that important discourse in learning is always direct and declarative" (p. 40).

In a description of modern German schools, which generally have a constructivist learning format, Zahorik and Dichanz (1994) report that the classrooms are characterized by scaffolding, reflection, independent individual and group activity and dialogue. Students constantly verbalize their perceptions, impressions, questions, solutions, and speculations. An example is given in which second-graders experimented with towers of blocks for a lesson about multiples of various numbers; while building the towers, the students continually spoke about their thought processes. The teacher, in addition to encouraging this sharing, challenged students' discoveries, asked for clarification, and extended their thinking in new directions. "This constant verbalizing enables teachers to see the state of students' internal knowledge structures and thinking processes and to adapt their responses to individual students" (p. 76).

Thinking aloud is crucial because interpretation of critical words varies greatly from one culture to another, and from experts to novices. Rogoff (1990) points out that semantic contingency (adult speech that expands, explains, extends, clarifies or answers in response to a learner's speech) promotes language acquisition and thought development. Commenting on situated learning, Damarin (1994) affirms that "without subscribing to the Whorfian hypothesis, I would note that in these contexts language is a behaviour; indeed the use of language is the major observable behaviour in writing, speaking, and teaching" (p. 20). Meichenbaum and Cameron (1981) ascribe particular usefulness to "think-aloud" and "thought-listing" techniques, which they suggest be combined with self-report inventories, open-ended interviews, and observation of behaviour for the purpose of cognitive assessment.

Marzano *et al.* (1988) denote think-aloud to be a key pedagogical method because students who make meaning by stating academic process in their own words demonstrate a depth of understanding well beyond what is reflected in recitation or in the recognition-testing

of many paper-and-pencil tests. "To become conversant with a subject is to have used oral discourse in significant and personal ways" (p. 64).

As Vygotsky (1987/1933) established, social interaction provides the grounds for verbal communication and at the same time supports the extension of students' understanding to new information and activities, as articulation of an experience or idea requires relating it to a known class of phenomena, thereby generalizing the phenomenon in order to communicate. The intent of using think-aloud in cognitive apprenticeship is summarized by Brandt, Farmer, and Buckmaster (1993):

The goal should be verbalization of thoughts that occur during performance, descriptions of thought processes, summaries of internal speech and what the subject is sensing, and explanations of the reasons for particular types of thinking.... The spoken thoughts add a dimension to the learning process that is not present in other types of learning experiences. (p. 76)

5.5 Cognitive Apprenticeship in Clinical Nursing Education

Of special interest to nursing educators in clinical settings is the delineation by Farmer, Buckmaster, and LeGrand (1991) that cognitive apprenticeship is particularly appropriate when certain restrictions are present in the situation, such as when

- a) the learner and/or the instructor have to be concerned about performing the tasks effectively and efficiently;
- b) to be minimally satisfactory, what is to be learned has to be done in specified, approved ways in keeping with the expectations of society and a segment of society, such as a profession, rather than merely in whatever way individual learners may prefer;
- c) the learner can learn something from observing and hearing a model performing the real thing that cannot be learned easily any other way, because it has not been and perhaps cannot be codified in the professional literature, such as how and why the model reacts to real life decision points.

A decisive aspect of situated learning in an acute-care hospital setting is the element of risk, as students' actions can potentially endanger the well-being of their patients. For this

reason, the teacher's close involvement is essential and the milieu is conducive to a cognitive apprenticeship approach, as opposed to the less structured "discovery learning" or "personal empirical enquiry" (Hansler, 1985).

In defining the paradigm of his study of critical thinking skills, Smedley (1991) identified three characteristics of the health professions which make them suitable for the cognitive apprenticeship approach:

1. They tend to be based upon a historical apprenticeship model in which mentoring, modeling and coaching represent major learning strategies;
2. The primary focus of these professions is examining patients and illness/wellness issues based upon a broad continuum of outcome possibilities with multiple alternative states;
3. The health professions' emphasis on peer interaction and association make them a prime target audience for relationship building, consensus formation, and peer grouping.

However, a drawback to applying cognitive apprenticeship models in clinical nursing is the potentially negative image associated with the term "apprenticeship". Hay (1993) notes that traditional apprenticeships can be sectarian, dictatorial, controlling, divisive, exploitative, and cliquish. "The use of the term apprenticeship has also been criticized because the characteristics of master-apprentice relationships in many cultures may represent too narrow a view of situated learning" (Orey & Nelson, 1994, p. 4). Lave (1991) concedes that apprenticeship has often involved the exploitation of apprentices as sources of cheap labour and the reproduction of structured inequalities of social class, but affirms that this is not a necessary integral aspect of apprenticeship. In the field of nursing, there is an apparent reluctance to use the term because of the historical subservience of nurses within the health care system and because of the traditional focus on their "training" rather than on "education".

This can be seen in the following critique of traditional apprenticeship:

Nursing students have been sent to the clinical setting to gain work experience rather than to achieve educational objectives. Novices have been given almost total responsibility for patient care and have been supervised rather than taught. This misuse of clinical experience continues today in many places. (DeYoung, 1990, p. 197)

Therefore, use of the term cognitive apprenticeship in the clinical nursing context needs to be clarified to prevent misunderstandings of intent. But according to Roth and Bowen's (1995) survey of educational literature, it seems to be understood that when the term is used in the cognitive sense, it does not reproduce the economical and sociopolitical dependencies of traditional apprentices.

5.6 Applications of Cognitive Apprenticeship

Think-aloud physical assessment as conducted in this study is just one of many possible directions for the cognitive apprenticeship approach. Gruender (1996) insists that "even constructivism is itself a construct. This means it is fallible, and not a dogma, and that we are capable of testing it within normal human limits, and able to apply it where these tests show it promises to produce good learning" (p. 28).

Numerous successful applications of cognitive apprenticeship theory have been reported. For example, Brown and Palincsar (1989) structured a method of guided, cooperative, reciprocal teaching for reading comprehension in elementary school. Applying cognitive apprenticeship in a grade eight science classroom, Roth and Bowen (1995) report that the process fosters a culture of sharing and peer learning. Schoenfeld (1985) found that building the elements of cognitive apprenticeship into his teaching of mathematical problem solving was remarkably effective in helping students to grasp the pertinent concepts. Gardner and Boix-Mansilla (1994) suggest the design of "teaching for understanding" through actively engaging students in generative topics, ones that engage the students and are accessible to them. The goals must be articulated by the teacher and overtly shared with the students, guiding them to construct their own answers to essential questions. As Gardner (1991) points out, apprenticeship methods yield students whose potential for understanding is engaged and enhanced. Jarvela (1994) concludes that successes have been reported as "the cognitive apprenticeship model has been broadly applied in empirical experiments in different domains" (p. 2).

Various reasons account for the effectiveness of the apprenticeship model. Some of these are listed by Rogoff (1991) in specifying that

- apprentices are active in gathering information and practicing skills as they participate in skilled activities;
- the learning of apprentices is structured by practices developed by their predecessors to meet societally valued goals;
- apprentices are assisted in their learning by communication and involvement with more skilled people (experts and more advanced apprentices) who help determine how to divide the activity into subgoals that a novice can begin to handle, as well as provide pointers on how to handle the tools and skills required;
- apprentices are often in a community of relative novices, who provide challenge, support, collaboration, and models of learning in progress.

6. Summary

The literature clearly substantiates this project's sociocultural constructivist approach to learning physical assessment, situated in an authentic context of clinical nursing. The key contributions of language have been reviewed, supporting the project's emphasis on think-aloud. The pertinent facets of perception have been examined, undergirding the belief that accurate physical assessment requires not only sensory data but also domain knowledge and attitudinal openness. This in turn shows the need for a reflective learning environment which supports cognitive development. The theory of cognitive apprenticeship emphasizes the characteristics sought in such a teaching/learning setting, and thus has been adopted as the guiding framework for this project.

CHAPTER III

METHODOLOGY

To meet the research objective, an exploratory process examining the theory and practice was employed. Both components were approached from a non-positivist stance situated within a conceptual framework of cognitive apprenticeship with a view of cognition as a socially mediated activity. The literature on cognitive apprenticeship was reviewed in books, journals, conference reports and electronic media. Then this clinical project was developed and implemented using participatory action research, in which student feedback and teacher observations continually shaped the think-aloud method itself. This section presents the design of the research and the methods used for collecting data. Specific limitations to the project are delineated, and the participatory role of the teacher-researcher in relation to the process is depicted.

1. Research Design

The research subjects were second-year nursing students enrolled in Maternal-Child Nursing (course #180-310/410) at Dawson College in Montreal, who were assigned to the researcher's clinical groups in the winter and fall of 1996. The first group consisted of five students in the winter semester, the second group had six students in the fall semester, thus the total sample from the two courses was eleven persons. All participation was voluntary, and the students signed a consent form assuring them of anonymity, safety, and that their academic standing would be unaffected by their participation in or withdrawal from this project (Appendix B).

Each semester was fifteen weeks long: the first half of each course was conducted on a surgical unit of the Montreal Children's Hospital, the second half took place on the obstetrics unit of the Royal Victoria Hospital. Each half began with two weeks of laboratory sessions at the college, following which the students spent two consecutive days weekly in the clinical setting.

The teacher-researcher used think-aloud in teaching these students the physical assessment of infants and young children. This took place in sequential steps. A prerequisite task for the students was the reading of assigned chapters in their pediatric and obstetric textbooks, in order to have a basis of domain knowledge. In the nursing laboratory at the college, the teacher demonstrated physical assessment procedures on mannequins, with detailed explanations of the content to be observed. In the hospital, assessment was modeled by the teacher on actual patients, with concurrent verbalization of the thinking processes involved as data was gathered and decisions for action were taken. Then the students and teacher jointly worked through other patient assessment processes using constant verbal articulation, with peers observing and participating in the verbalized interpretation and prioritization of data.

The students were instructed to state everything they noted about the patient and all thoughts they had regarding what the data may signify. In addition, they were asked to say out loud any musings regarding possible nursing actions related to the data, and to note any data that would still need to be obtained at another time or from another source. These comments were supplemented by the teacher's guidance and questions. As the students' competence increased during the semester, the teacher withdrew her coaching support. Finally, the students independently assessed their patients using continuous monologues. The teacher observed and listened to their performance, noting the student's fluency and behaviour during the process, the accuracy of the results, and the students' "retrospective reports" (Ericsson & Simon, 1981, p. 19) as stated orally following the assessment task.

In order to emphasize thinking not only about the data but also about the thinking processes themselves, students and teacher engaged in the joint and individual reflection-on-action advocated by Schön (1987). The students' and teacher's impressions of the various physical assessment procedures were compared and contrasted in two settings: immediately upon completion of the task in a one-to-one discussion on the ward, and then in group conferences held at the conclusion of each clinical day. The students were asked to report how they felt about doing the assessment, whether they understood the significance of specific data noted, what nursing actions they undertook as a result of the patient assessment, and what questions they still had. This encouraged students to identify their own gaps in domain

knowledge and discuss resources to supplement their information. Follow-up activities to augment their understanding of the patient's condition, such as research in textbooks or presentations to the group, were devised and conducted. Dialogue among peers and between teacher and students was encouraged at all times.

The research process was iterative -- the implementation strategies subtly changed as feedback was obtained from the students and lessons were learned from the teaching experience. As Janesick (1994) specifies, in qualitative research design "there is a continual reassessment and refining of concepts as the fieldwork proceeds" (p. 214). Beyond the predictable increasing ease of the teacher and students in using think-aloud, the major changes were two-fold. Firstly, the step following the teacher's modeling, when the student and teacher jointly perform the assessment, was found to be difficult to implement because the unequal power relations tended to inhibit the student. Involving peers from the outset proved to mitigate the problem very effectively. Secondly, despite the fact that the linkage of assessment data to nursing action was discussed frequently, during the first semester there was a somewhat inconsistent follow-through, as the students did not always implement the planned nursing care they had articulated. Thus, for the second semester a modification was made to their weekly journal format: on the self-evaluation page (Appendix C) a new item was added, namely to report "an example of an assessment fact that directly led to a nursing action." The students wrote the examples and the teacher emphasized the causal link more explicitly, with the result that implementation of planned actions was done more consistently.

2. Data Collection

Three methods of data collection were employed in this project: participant observation by the teacher-researcher, oral feedback in the form of non-structured group discussions and semi-directed individual interviews, and documents written by the students. These consisted of journals, reflection sheets, entry questionnaires and exit questionnaires. The specifics of each method follow.

2.1 Participatory Observation

A log was kept by the teacher-researcher of each clinical week throughout 1996, which included descriptions of students' assessment performances, their comments in discussions, the teacher's reflective notes, and information about the time, place, and date of the observation. As personal or pedagogical stumbling blocks to the use of think-aloud were encountered they were recorded, as were alternative tactics and successes.

2.2 Interviews

Oral data was gathered in group settings as well as in the individual sessions..

A. Group Discussions

In the seminar sessions held at the end of every clinical day, students' opinions and feelings about think-aloud were gathered informally. Information was obtained by noting spontaneous expressions of their views, eliciting conversational dialogue and conducting non-structured group interviews. The data collected was recorded in the teacher's log.

B. Individual Interviews

Following completion of their course, the students were invited to participate in individual semi-directed interviews (Appendix D). An open-ended format was used, to allow for flexibility and in-depth conversations between participants and researcher (Fontana & Frey, 1994). Questions focused on the students' feelings about using think-aloud and how they viewed the contributions of peers and teacher. They were asked to identify aspects they found helpful or unhelpful, to describe the link between assessment and nursing intervention, and to evaluate their own competence and comfort with physical assessment and the nursing process. The discourses were tape-recorded and transcribed by the researcher.

2.3 Student Documents

A number of written data resources were provided by the participants. These included journals, reflection sheets and, for the second group, entry and exit questionnaires.

A. Journals

The students submitted written weekly assignments which included categories of objective and subjective patient assessment data, data analysis, and nursing care planning. One section of the journal was a self-evaluation in which the students recorded their own views of their performance (Appendix C). This facilitated the communication of any feelings the students desired to share with the teacher about the clinical experience. The teacher responded via written feedback, pointing out areas of strengths and weaknesses, and answering the questions posed or the concerns expressed.

B. Written Reflection Sheets

At the end of the initial (winter) semester, the students were asked to privately complete a reflection sheet about the think-aloud method (Appendix E). This had an open-ended format with a few suggested subjects, such as how they felt about the think-aloud method, whether doing assessments this way helped them link data to nursing actions, whether they felt more competent now, and how they viewed the role of peers and of the teacher during their assessments.

C. Entry Questionnaires

As the project unfolded it was recognized that having baseline data about the students' familiarity with physical assessment would be helpful. Therefore, the second group was requested to fill out an entry questionnaire (Appendix F) at the beginning of the fall semester. In this seven-item questionnaire they were asked to identify their previous assessment experiences on a mixed scale, and to rank their level of comfort and competence in performing physical assessments. They were also asked for a description of the experience that had helped them the most in learning it, and to state the main function of data gathered in assessing a patient.

D. Exit Questionnaires

Correspondingly, the written reflection sheet format used by the first group was changed to an exit questionnaire for the second group (Appendix G), which was completed at

the end of the fall semester. It consisted of seven multiple-choice items in which the students ranked their level of comfort and competence in performing physical assessments, their opinions of observing teacher and peer modeling, their feelings about assessing in front of peers, whether they anticipated transferring think-aloud skills to silent assessments, and an evaluation of the amount of discussion time before and after their assessments. It also contained four short-answer items. Two of these were identical to the ones posed in the entry questionnaire, namely to describe the experience that had helped them the most in learning physical assessment, and to state the main function of the assessment data gathered. Then they were asked whether they felt that the think-aloud should continue to be used for teaching physical assessment, and lastly there was a space for any additional comments about this method.

3. Limitations

The main limitation to the study was imposed by the fact that it is not always possible nor advisable for health professionals to articulate their thoughts in the presence of the patient, as doing this can cause confusion and embarrassment to the patient. However, this problem was avoided by limiting think-aloud to the physical assessment of infants and young children who did not understand the words being said and whose parents were not present during the actual assessment process.

The sample size was small, but was consistent with the curriculum structure of the college where it took place. Conducting the same research with two different groups of students made the study more robust. Validity and reliability of conclusions was enhanced by the use of a variety of data collection methods and multiple data sources within the project, producing a triangulation of method and of data (Janesick, 1994). Rigor was assured by having complete documentation available for audit. The use of direct quotes from the research subjects was seen to add authenticity to the report. The study did not aim for broad generalizability or guaranteed replicability, as the particularities of every clinical setting make this untenable.

The absence of standardized pre- and post-tests to judge changes in the students' assessment abilities could be seen as a limitation. But as Jarvela (1994) points out regarding studies of cognitive apprenticeship programs, "although there has been evidence of successful outcomes, the qualitative analyses of the learning interaction are deficient, since earlier research interests in cognitive apprenticeship learning have mainly focussed on learning outcomes" (p. 2). Thus the project did not undertake a quantitative measurement of outcomes. However, the teacher's expertise in the profession allowed for on-going qualitative evaluations of students' clinical performances as well as of their written reports. These were reviewed in a comprehensive and contextual manner that exceeded the scope of formal testing and provided formative evaluations for the students.

Unanticipated limitations abounded: linguistic hurdles for non-anglophones trying to express their thoughts in English, cultural taboos regarding the frank articulation of private thoughts, social barriers to verbalizing critical views, and gender restraints in physical assessments of patients of the opposite sex. However, these difficulties were all overcome with time, practice, encouragement by the teacher, and the students' dedication to mastering the task. Thus the challenges encountered did not pose a serious hindrance to the implementation of think-aloud.

4. The Researcher's Role

The project took the form of action research in which the researcher developing and evaluating the method was also the teacher implementing it with students in the field; as L. Smith (1994) states, "action research involves teachers studying their own teaching" (p. 301). Similarly, in a project applying cognitive apprenticeship in science education, Roth (1993) specifies that "the present study was situated in the traditions of action research and reflective practice: it was designed by me, a classroom teacher, to understand and improve the learning in my classrooms" (p. 353). The use of "personal experience methods" (Clandinin and Connelly, 1994, p. 417) includes participant observation, to gather impressions of the situation firsthand and record behaviour as it occurs (Adler & Adler, 1994). The recorded information contains not only descriptions of events but also quotations and reflective notes (Creswell,

1994); such a narrative of experience yields "contextualized materials that are historical, relational, and processual" (Denzin, 1994, p. 511).

On the one hand, the teacher-researcher's active participation in the elaboration and execution of the project constituted a limitation, as the researcher did not engage in neutral collection and interpretation of facts, but rather used constant comparative methods to channel the project into a successful use of think-aloud. She obviously hoped that the students would indeed benefit from this method of learning physical assessment. To lessen the biasing influence on the students' responses, the researcher

- a) assured all students that their participation in the project would have no bearing on their clinical grades;
- b) instructed the participants to fill in the questionnaires anonymously;
- c) completed all clinical evaluations and assigned grades before the students were asked whether or not they would be willing to participate in interviews;
- d) collected the reflection sheets and conducted the interviews following the end of the semester.

On the other hand, the researcher's personal involvement led to the development of trusting student-teacher relationships, which are a crucial element in any mediated learning experience and particularly in cognitive apprenticeship (Rogoff, 1990). The participatory action research also provided primary source material and a comprehensive grasp of the project's context by the researcher. The ultimate goal of the project was not to prove a point or explain the results, but instead to understand the process -- "*verstehen*" rather than "*erklären*" (Tochon, 1994). For achieving this aim, the direct participation by the researcher proved to be of great value.

CHAPTER IV

DATA ANALYSIS

The objective in analyzing the data was illustrative, to see how think-aloud could be applied to the teaching of physical assessment of infants and young children, and to fully understand the process of implementing such a method in hospital settings with nursing students. The data collected during the course of the research project was examined in two ways.

First the teacher's log, student documents, and interview transcripts were reviewed for indications of the presence or absence of the characteristics described by Collins, Brown, and Newman (1989) as being desirable in a learning environment. Any such indications were noted and classified according to the outline suggested by these authors. Thus a theoretical structure was applied to the material in order to discern whether the results obtained matched the desired outcome.

Then the data was examined without an exterior model, in an attempt to identify themes emerging from the data itself. Recurring motifs were recognized and described. This inductive approach allowed for a more grounded understanding of the data and enriched the researcher's comprehension of the results. Both strategies are reported here. All quotations from participants are presented in authentic, unaltered form.

1. Identification of Characteristics of the Think-Aloud Learning Environment

The cognitive apprenticeship model proposed by Collins, Brown, and Newman (1989) lists the main characteristics which an exemplary learning environment possesses. The findings of this research project offer indications of the presence or absence of these features, categorized as the sociology of learning, the sequence of instruction, the content of instruction, and teaching methods.

1.1 The Sociology of Learning

The social organization of cognitive apprenticeship can foster productive attitudes about the nature of learning that are significant to learners' motivation, confidence, and orientation toward problem solving. It contributes to students' understanding of multiple forms of expertise and leads to the development of cooperative learning styles (Collins, Brown, & Newman, 1989). The research data was examined for the following critical elements: situated learning, a culture of expert practice, intrinsic motivation, exploiting cooperation, and exploiting competition.

A. Situated Learning

The activity in which knowledge is developed and deployed, it is now argued, is not separable from or ancillary to learning and cognition. Nor is it neutral. Rather, it is an integral part of what is learned. Situations might be said to co-produce knowledge through activity. Learning and cognition, it is now possible to argue, are fundamentally situated. (Brown, Collins, & Duguid, 1989, p. 32)

Situated learning refers to acquiring knowledge and skills in contexts that reflect the way in which the domain's conceptual tools are used in real problem-solving. It is one of cognitive apprenticeship theory's basic premises; as Collins (1988) expresses it, situated learning is "the sine qua non of apprenticeship" (p. 2).

In this project the students were located in the hospital setting, were immersed in the nursing tasks of direct patient care, and were performing assessments of the patients for whom they were responsible. Situated learning involved the teacher structuring the assessment process in a manner that was supportive to the students and within the parameters of safety for the patients. As Miller and Malcolm (1990) emphasize, "students need to experience the attitude of freedom and have the opportunity to risk without fear of personal failure and without risk of harm to clients" (p. 70). In individual interviews, the participants expressed evaluations of their learning experience in terms that validated the project's situated approach, for example: "I learned more from assessing in the hospital a patient directly than studying from the book and remembering and trying to do it myself. It was more helpful." In a reflection sheet was written: "No books or lab-classes could be as effective as the 'real-life' practical experience in the

hospital." An exit questionnaire response specified how the setting and think-aloud method had helped:

In postpartum was where I found the assessment was most useful. We had the chance to look at pre-, term, post- infants and so thus examined the differences and it brought much of the theory we had learned in class together.

Another student said in the interview:

I found it helped a lot, because you actually got to do it, like, and see. Not just when you hear it in class or when you see it on a video. It's like now you actually get to do it... And let's say there's something wrong with the baby, well you actually get to see it, what it is. Because when you just describe it, it's hard to know what it actually looks like. So you might doubt yourself when you're actually looking at it and things, but when you're there with us doing the assessment and you say "well ya, this" or you back us up, well then we know what we're going to be looking for and things like that, so it helps a lot.

The underlying self-doubt revealed in her comment is described by Milner and Collins (1992) as typical, in that student nurses are easily overwhelmed by the reality of being assigned to a client who has problems and symptoms the student has never encountered before. "It is not surprising that students tend to discredit their own inexperienced findings and readily accept the staff's previously documented assessment data, which are not necessarily accurate or current" (p. 186).

Correspondingly, another student commented on the empowering effect of doing physical assessments using the think-aloud method, comparing it to her previous reliance on other nurses' written assessments of the patient:

Before I started to do this assessment I didn't know how to perform a nursing action because I didn't know the data, how to get the data myself. I always depended on the chart, whatever in the chart I just read it and went through the data in the chart, but through this assessment it was really helped that I can perform the nursing action as myself, so I don't have to depend on the chart.

In addition to building the students' self-confidence, the project encompassed a broad range of factors in the situatedness of clinical work. As Rogoff (1990) describes cognitive apprenticeship, it is a guided participation in which the distinction between cognitive, affective, and social processes become blurred, as the goals are contextually situated and involve the

learner's feelings and values. Harley (1993) depicts situated learning as the "fusion point" between a student's previously acquired personal knowledge and new knowledge "substantively defined by the collective agreement of experienced practitioners in a knowledge community" (p. 46).

The teacher's log reported her effort to contextualize the assessment process at the beginning of each semester: in group discussions, the students' views were elicited on the relevance of physical assessment, their previous experiences with it, as well as their feelings about performing assessment and how to overcome timidity. The log also recorded instances where students' personal lives directly affected their patient assessments. For example, one very capable student suddenly performed poorly and spoke abstractedly in her think-aloud, only disclosing later that she was preoccupied with a sister's health crisis at home. Another student gave minimal attention to his assessment and shortly afterwards had to be sent home due to the onset of the flu. These events were dealt with by the teacher as representations of the interconnectedness of the many facets that impact on a nurse's effectiveness, and the group was encouraged to reflect on these linkages. More positively, who the students are as persons, and the life experiences they bring to the task, was frequently invoked as a source of strength within the clinical context. The students were encouraged to reflect on their personal experiences, particularly in connection with childhood memories of hospitalization. According to the log, this surprised and pleased the participants.

B. Culture of Expert Practice

The philosopher Oakshott (1962) wrote that to work alongside a practised scientist or craftsman is an opportunity not only to learn the rules, but to acquire also a direct knowledge of how and when to apply the rules; "until this is acquired nothing of great value has been learned" (p. 92). As Bromme and Tillema (1995) maintain, "the cognitive foundations of professional activity are influenced, shaped, one could even say pervaded by expert experience" (p. 263). Tripp (1993) concurs that "true expertise is learned by being exposed to experts" (p. 75).

Of particular interest for developing expertise in the specialized world of hospitals is the emphasis found in cognitive apprenticeship on familiarizing students with not only expert skills but also the expert culture. As Evans and Johnson (1991) state,

Learning is as much a process of enculturation in a particular discipline as it is the result of abstract learning activities. It involves not merely knowing the "rules" of a particular concept but also an understanding of how the concept is used within the community and culture of its discipline. If knowledge is viewed as a "tool" then the learner's task is to develop an understanding of both the nature of the tool and how the tool is used by the members of the appropriate cognitive community. (p. 4)

In this project the physical assessment techniques were taught as a fundamental part of the overall nursing care given to hospitalized patients. This involved presenting the broad aims of nursing intervention and discussing with the students their role within the health care system. Brown, Collins, and Duguid (1989) describe communities of practitioners as being connected by more than their ostensible tasks, they are bound by intricate, socially constructed webs of belief, which are essential to understanding what they do. Too often students are asked to use the tools of a discipline without being guided to adopt its culture. The authors maintain that activity, concept, and culture are interdependent, and learning must involve all three. Harley (1993) agrees:

learning and enculturation go hand in hand, and it is this phenomenological aspect of learning and affordance support that students need to access in preparation for when they go beyond the learning situation to the "real world" in which the learning is expected to be applicable. (p. 48)

Both groups of participants had previous experience in real hospital settings, thus for them it was not a totally new environment. But none had nursed infants before, nor had they encountered the attitudes of nurses who work with children, nor had they experienced the specialized ambience of the pediatric and obstetric environments. The teacher's log indicated that much time was spent discussing the new settings and helping the students make sense of what they were seeing happening around them. As one student recalled in the interview: "It was a shock for us to be in Pediatrics, you know, to see sick kids it's a new experience, to be responsible for more things than before, and everything."

Palincsar (1989), who defends the acculturation of students into solely the academic environment, asks: "What is the mystique of a practitioner's culture that the student must assimilate? In many disciplines, there may be much less of a shared culture than the authors assume" (p. 6). However, there is no doubt that for these students there was a significant need to become acquainted with the hospital culture, a clearly demarcated area with many strata of rules and customs (Boston, 1996).

Barer-Stein (1991) asserts that "learning and habitual practice form the essence of all cultures, including that of professionals.... The learning of a culture implicates all the domains of learning: cognitive, affective and psychomotor" (p. 40). The participants demonstrated this process as they acquired new knowledge, confidence, and skills. Finding their way in the hospital culture was helped by the fact that they perceived the institutional structure as an expert resource. For example, in one of her journal entries, a student described her summoning of the professional staff: "I noticed that the ureteral stent was not draining. I checked for any kinks or visible obstructions. When I didn't find any, I notified the RN who paged urology." Another instance recounted a student's response to an emergency: "I immediately called you (the teacher) and found out who the boy's nurse was." Clearly the novices felt supported by the expert milieu.

In preparation for performing psychomotor tasks, the students would commonly observe a nurse do the procedure before attempting it themselves. Patient assessment, however, was seldom modeled by the nurses; in response to one student's query about how she determined her patient's status, a nurse stated: "You just know." Tripp (1993) cautions that "transferability requires abstract representations of tasks -- but abstraction is precisely what experts don't use in their action" (p. 73). Barer-Stein (1991) describes "the difficulty we each feel in attempting to bring to the surface of our conscious awareness what has already become habituated" (p. 43). The result can be a certain mystique of professionalism, as a timid student expressed when asked what would strengthen her weak self-confidence: "Oh, probably graduating and being a nurse, that kind of experience you get later on."

As urged by Collins, Brown, and Holum (1993), "we need both to understand the nature of expert practice and to devise methods that are appropriate to learning that practice" (p. 8). In a study on expertise, Lampert and Clark (1990) warn that "experience does not constitute expertise. Yet if we reject the equation of experience with expertise, we are left with the difficult question of how to decide who is an expert" (p. 22). Winn (1994) distinguishes the way a teacher knows a subject from the way a subject matter expert knows it, saying that the teacher's perspective makes it teachable: "The knowledge is organized along pedagogical principles as much as by its native structure. The teacher uses this unique way of knowing a subject to make it accessible and comprehensible to students" (p. 12). Thus Brown, Collins, and Duguid (1989) conclude that students need to be exposed to teachers acting as expert practitioners in the field.

The teacher-researcher in this project had over twenty years of professional experience, in working as a pediatric nurse and teaching the subject matter to nursing students. Comments from the participants made it clear that they valued this, as it afforded them a sense of security during their assessments: "Actually I would be glad you would be there, in case I was missing something vitally important, and of course I knew you would pick up on that, so that the child would get proper care." In the reflection sheets, one wrote that "having the teacher was reassuring in that the teacher would notice any abnormalities that I might miss." And in the interview, a highly competent student affirmed:

I absolutely need your presence there! Yes, because if it's only students, often we are not sure in what we are doing. It's good to have somebody there knowing what's the right thing or what to do, in case we don't know. We need to know the right thing, it's important.

Another student noted the teacher's role in data interpretation:

When I did it with you out loud, I found that because you have expertise, you've been working in the field for a while, something that to me might seem serious or that I might be concerned about, because you were there with me you would tell me "Oh well it could be this, that or the other thing", so it gave me added expertise. Whereas if I was doing it by myself in my head maybe something would be really serious to me or I

would be worried about it and it wouldn't be anything at all, or something that I'm not looking at could be overlooked. So I found that was helpful.

A recurring theme in studies of expertise is that while novices use knowledge of surface structures, experts use action schemata (Chi, Feltovich, & Glaser, 1981). Bereiter and Scardamalia (1992) comment that "novices cannot really be expected to do otherwise, since they lack the requisite knowledge", but suggest that "it may be possible to fashion instruction and problem-solving activities from the earliest stages so as to lead in that direction" (p. 534). The continuous thinking aloud by the teacher, and the on-going emphasis on patterns of analysis leading to concrete action, were attempts to facilitate this. As a student said, chuckling, "Ya, ya, each time you told me 'ok, this is your nursing action, why you do this?'"

Damarin (1993) reproaches situated cognition theories for reifying arrogant perceptions of expertise, and she posits the individual student as the source of knowledge. Eschewing either extreme, this project was simply aimed at helping novices begin the process of learning to think like experts. Responses from the participants validated this approach: "The thinking about assessing and the actually doing it, it became like one," said one student being interviewed, and another said with shy pride: "It was more like I was able to work as a professional nurse."

C. Intrinsic Motivation

Intrinsic motivation, the incentive that governs the learning situation and is not dependent on external rewards, arises when students are engaged with interesting or at least coherent goals (National Council on Vocational Education, 1991). An important step is for the teacher to overtly clarify the goals for understanding (Perkins & Blythe, 1994), since this helps the students to become more involved in the project and more at ease in exploring and assessing their achievement of the goals. As Unger (1994) encourages, "let students know that their education is not something that you, the teacher, do to them" (p. 10). According to Palincsar (1989), "situated cognition is important because it can give students a sense of agency in their learning" (p. 6). To assure intrinsic motivation, students must see themselves as generators of

knowledge rather than as recipients of information (Freire, 1970). Prime examples of this were found in the student journals:

When I walked into the room first thing Friday morning, the baby was lying on mum's bed in only his diaper and crying so loudly. Mum and dad looked really worried. They said they had tried everything: feeding, holding, changing, but it wasn't working. So I taught them that baby was feeling a little out of control so loose, and probably cold. I bundled baby and he almost immediately stopped crying. Dad and mum were amazed.

The implied sense of accomplishment was sometimes expressed directly, as when a patient's parent showed gratitude and the student wrote in her journal: "She thanked me a lot which made me to feel good" or when reporting an intervention which worked: "The baby would get very upset when her mother left. By picking her up and rocking her she would calm right down. I loved having the experience of working with an infant!"

In group discussions, as recorded in the teacher's log, a notable difference emerged between the two groups of students. The winter group, who had already done a semester of adult medical-surgical nursing, began by saying that they felt very unsure about how to perform assessments even though they all believed it to be an important skill. Their motivation was already at a high level, and they responded to the proposed project with immediate vigour. Their motivation continued unabated and indeed escalated as the term progressed; when two of them missed an assessment session in week 13, they arranged to perform an assessment together the next clinical week, showing an eagerness that clearly indicated the value this learning held for them. An excerpt from the teacher's log reports:

We were so intent on our task and there was such an atmosphere of excitement as they discovered the babies' attributes, that some nurses came over to listen in, and another instructor asked what was going on. When the students happily replied that we were "assessing!" she looked dubious and drifted off.

For the autumn group, who came from the minimal nursing experiences of first-year studies, the affective factors appeared to be inversed: the students gave little indication that they perceived physical assessment as a major issue and seemed less concerned about their own skills. According to the entry questionnaires, only half of them had ever done a complete patient assessment, yet all claimed to feel either "usually" or "sometimes" comfortable in assessing.

They seemed to not recognize the key role assessment plays, therefore much of the conference time in September was devoted to discussions of the way in which assessment data lays the basis for constructing nursing care plans. Freire (1970) insists that real education and a critical perception of the world must grow out of students' own thinking. Therefore in this project much emphasis was placed on contextualization: listening to the students' viewpoints, identifying their existing skills, enlarging their repertoire, placing their nursing actions within the framework of an on-going evaluation of their patient's health state, and encouraging them to relate their findings to their plans. The students in the autumn group were asked to write in their journals a specific example of an observable consequence of their patient assessment (Appendix C). They did this every week, and were given verbal and written feedback from the teacher encouraging their reflections. Gradually the students adopted these notions as relevant to their own thinking: they commented that due to their think-aloud assessments, the nursing process as a whole was becoming more comprehensible and coherent to them. Their pleasure in reporting this indicated that their new understanding was a source of satisfaction and motivation for them. A number of them indicated a sense of progress in comments such as: "I can't believe how I didn't have a clue at the beginning of the semester." In the individual interviews, a typical assertion was that in contrast to their earlier ignorance which they now recognized, by the end of the semester "I knew exactly what I was looking for. I was, you know, a **pro**, yeah."

D. Exploiting Cooperation

Cooperation is inherent in everyday interactions, as individuals attempt to solve problems by interacting with other people using socially provided schemata and contextual cues (Choi & Hannafin, 1995). While cooperative learning as an instructional tool is "not a panacea" (Anderson, Redner, & Simon, 1996, p. 10), it holds a place of importance in situated learning in general and cognitive apprenticeship in particular, as it "implies a culture of sharing and learning among apprentices" (Roth & Bowen, 1995, p. 77). According to Rogoff (1990), "shared problem solving -- with an active learner participating in culturally organized activity with a more skilled partner -- is central to the process of learning in apprenticeship" (p. 39).

The students in this project participated in frequent cooperative peer interactions during their physical assessments. The teacher's log recorded the ways in which pairs and groups were formed and reformed on a daily basis. Some groupings were carefully planned by the teacher to maximize case exposure or to combine complementary skills, others happened by chance as one student became available to watch and assist another. Every student participated in a whole-group assessment led by the teacher, observed peers doing assessments, and performed assessments with one or more peers observing.

Despite their varying skill levels and different personalities, the students' reactions to this pattern were astonishingly uniform. At first they were shy, then quickly gained confidence and eventually displayed obvious enjoyment of the task. In Barta's (1993) study of scaffolded cooperative learning, he also notes that "as collaboration and trust increased, the dialogue became more fluid and dynamic. Students began taking notice of the solutions suggested by a peer and they questioned a peer for further clarification" (p. 31). In this project, students' reflections during the interviews confirmed the teacher's observations, for example: "In the beginning I was a little nervous and I didn't know exactly what I was doing when I first did the assessment, but at the end of the rotation I was really, I can see the difference... I was really confident." Another recounts:

At the beginning of course I was always looking up and making sure: "Am I doing this right? Am I missing anything?" And then when we did it with other people, well they contribute to what you missed, so at the end you remember what the other people said, so you become more confident because you remember more.

According to Piaget (as cited in Rogoff, 1990), cooperation is the ideal social interaction for promoting novice's cognitive development because of the balanced reciprocity in comparing ideas, which creates cognitive conflict and leads to resolution, whereas discussions with experts are unlikely to lead to cognitive restructuring due to the unequal power relations involved. For example, one student explained the special role of her peers in this way: "It was very good for me to have them because they can correct me and it's better than when the teacher corrects you, because it's like a part of me, you know, we're all one team."

In contrast, Vygotsky (1981) emphasizes that ideal learning partners are not equal in skills, thus a novice should work with an expert in joint problem-solving; without this asymmetry, the novice will not advance. One participant recognized this when she complained to the teacher about being left with another student to do an assessment: "You give a certain kind of structure to it, I don't know, it's different. It was different when you were there." But the myriad experiences they were having quickly created different skill levels amongst them, as witnessed by the student who missed one clinical week and expressed wonderment at the advances her peers had accomplished in their physical assessment performances when she returned.

In this light, Rogoff (1990) points out that because the learning process is very individually paced, students can serve as experts to each other in different tasks. She maintains that collaborative effort can lead to a level of understanding unavailable in solitary endeavour or noncollaborative interaction, and suggests that the crucial factor may be the extent to which partners share in problem solving and establish a common ground for their interaction, "from which they may proceed regardless of asymmetries in their status, expertise, or particular viewpoints" (p. 176). In a study specifically designed to evaluate cooperative problem solving, Rogoff (1991) found that children who had initially collaborated with adults subsequently performed better on their own than did those who had worked with either trained or untrained peers. "Dyads with adults frequently involved explanation of the optimal strategy or strategic thinking aloud, forms of guidance that were almost nonexistent in the peer dyads" (p. 356). In effect, this author bridges Vygotsky and Piaget by making the distinction between learning that requires primarily a development of skill or understanding, in which interaction with more skilled partners may be most useful, and learning that involves a transformation of perspective, for which interaction among peers may be best supported by an exchange of ideas on an equal basis.

In this project, each student assumed two positions related to patient assessment, namely as the one observing and the one being observed.

1. Observing others. Again and again the participants remarked on the educational value of watching their peers, and their comments revealed active assimilation and accommodation as they described the process, for example:

It helped me, because I was thinking about "how would I do it myself?" And so when she was saying something I would say "Yes, that's what I think," or when she was saying different I would say "No, I would say differently." So again, this is thinking, you know. You think again, and you think again, "Oh, this was a good answer from her, so I have to pick up, maybe this way was better, you know, to describe something." So it was interesting and useful.

This use of self-talk was a consistent feature of the students' reports on watching others. For example, one said,

it made me aware of key things to pick up on when my turn came. "Oh, don't forget this," or "try this," you know. So you do learn from each other. Watching the other student do it will sort of prepare you for when your turn comes.

In a practical manner, another student added that "sometimes they don't do it in the same order as you, or they don't do it the same way, so you could say 'Oh, yeah, you could do that'."

The only drawback mentioned by the participants was the limitation on their spontaneous articulation. A number of students had expressed the preference to complete their own presentation before other people added their comments, so this format was adopted at most assessment sessions. The most vocal student lamented that "it was good experience, but I always wanted to say something! (laughs) When some people are slow, it's understandable, but I always wanted to say something." Another eager student ranked observing others as "ok, but not as good as when I'm doing it personally. Because, well, I must say when there are other people doing it, I tend to want to jump in!" Fortunately there was always ample opportunity to hear everybody's contributions eventually, as discussion invariably ensued.

2. Being observed by others. Unanimous agreement was positive about this aspect as well, despite initial temerity. Responses invoked both the affective and the cognitive domains. Representative of commonly felt emotions were phrases attesting that peers "take a little bit of tension off" or "take the edge off." This was elucidated as follows: "I find that if another

student's there I'm not as nervous. Yeah, I'm not as nervous as I would be alone." In another interview it was explained that "you feel a little stupid at first and then you realize 'Oh, I learned something from them too,' so you feel ok." Comments in the written reflection sheets concurred that "responsibility was shared within the group, therefore less stressful, hence more learning took place." And exit questionnaire answers included: "Doing patient assessment in the presence of peers helped me a lot, because I felt more calm with support and help of other students" and: "This method makes students feel more comfortable when assessing a patient, especially with peers."

Marzano *et al.* (1988) recommend that a useful approach is to have students work in small groups, asking each other questions as an intermediate step to independent self-questioning. This was done frequently in the project. Cooperation as a learning strategy was evident in the steadily increasing verbal participation of the group, and in the eagerness displayed by the participants to gather in clusters to do the assessments. In the individual interviews, a strong theme emerged as students revealed the domain-knowledge support the group had afforded them: "It helped because if there was something missing then they would fill in." "You know that if you miss something, well someone else is going to say it, so you don't have to feel nervous." "I found it really helped because they could bring the information that you missed." "What was a good experience about it is whatever I could not pick up somebody else did pick up, and I learned from that." "If I don't know an answer, the other student could jump in and give the answer, and it's also a learning process for me." The written reflection sheets echoed this interpretation, for example: "Whatever I didn't think of during assessment was pointed out by someone else → effective learning through the input of other students."

However, when asked whether they perceived themselves as having taught others, many of the students reacted with gestures of surprise. It was clear that even though they had been acutely aware of their own benefits from the think-aloud method, few had considered the mutual effect. Half of those interviewed gave a qualified yes, expressing some doubt as to their contribution to peer learning, such as: "I hope so, I hope so. But I think that they've definitely contributed to mine." "Maybe I helped them with the order of how I was doing it and how I

was assessing." "It's possible." The other half energetically declared that they had definitely helped their peers, and expressed the satisfaction they derived: "Yes, I'm proud of myself. I could pick up on some things maybe nobody else could pick up, you know, it was like a give-and-take. And I felt that I articulated well." Another student said: "Oh, I was really proud. It was like ... you know something and you're telling them. (laughs) It was like a teacher!"

E. Exploiting Competition

Much of the competition in education is destructive because it pits students against one another; "for competition to be constructive, comparisons should be made, not on the products of student problem solving, but on the processes that generate the products" (National Council on Vocational Education, 1991). Rather than aiming to avoid making errors, the learning objectives for students should be defined as learning to recognize errors and using an understanding of them to improve.

In a number of interviews the notion of students being compared or comparing themselves to each other was raised by the participants. They emphasized that they had learned from their mistakes, but did acknowledge a certain anxiety, as one student expressed when reflecting on her think-aloud physical assessments:

The very first time it was a little bit uncomfortable, it was different. But the second and all the times after I felt good about it, because I didn't feel criticized. You didn't make me feel criticized, which I was worried about a bit at first, that others would pick up on my mistakes. But no, at the end it was good, well after the first time, I would say, I was feeling comfortable.

Competition seems to be inherently present in most situations of performance, and can provide a focus for students' attention and efforts for improvement. As one student explained,

When I heard some mistakes I thought about myself, if I'm going to do the same or just don't do it, just to see, because you can assess yourself not always, like, you forget what you said or you can't control what you're saying, like, but when you see somebody's mistakes you can always analyze it. Like for me it was helpful, I could tell myself "just don't say this, it's not right" or "just pay attention to this" and I could see easily the problem.

For those with strong self-confidence, the competition of comparing and contrasting merely added a form of learning, as one wrote in her reflection sheet: "Talk-aloud and discussions are great ways to learn interactively with fellow students, comparing knowledge base and improving on it." However, due to inequalities in language skills, there was the potential for judgemental competition in articulation. One of the foreign students said:

At the beginning it was hard ... because I didn't know the group well, you know, I didn't know how they reacted, because many things like my language and all. I don't know how they judge me, like maybe they just laughing what I'm saying. But after I learn better my students, my classmates, I felt much more comfortable.

Lampert (cited in Brandt, 1994) emphasizes that an important aspect to the teacher's role is to establish a culture of respect for other people's ideas, and that this social norm must be both modeled and made explicit. According to the teacher's log, the conferences were conducted in such a way as to promote active listening and respectful interactions. Students' opinions were acknowledged as meriting serious consideration, and positive feedback was given liberally for the thinking processes revealed by the speaker, even when the conclusions reached were pointed out to be erroneous. The students soon followed this example. At the beginning of the fall semester there was overt competition, expressed by a student verbally depreciating what a peer had just said; the teacher conceded the emotions expressed but pointed out that the different approaches to the issue both had possible advantages. Refocussing the discussion on process rather than product proved to be an effective strategy. The teacher heeded the counsel by Ellsworth and Sindt (1994) that "a teacher must create a classroom environment where students feel safe to express their thinking, where they trust their teacher and fellow students, and where they understand the difference between criticizing ideas and criticizing people" (p. 43). Overall, group dynamics seemed to go smoothly, but as one student pointed out,

it's for sure that a teacher wouldn't know what is going on in a group between the students, there's no way to know what is going on. Always, even though you see that the group is functioning well, you always have to have an idea that ... they may have some problem.

Being sensitive to such undercurrents is important in avoiding the negative effects of competition. One of the participants recognized a degree of tension between herself and another student, leading her to qualify that think-aloud assessments are

good, as long as the other person is not uncomfortable with us being around them. And that would be the only thing, if somebody felt uncomfortable, maybe just to make sure that they don't mind. I don't think most people would.

Collins, Brown, and Newman (1989) suggest that the discouraging effects of competition can be reduced by individuals working together in groups to compete with other groups. Such a structure was not attempted in this project, as the cooperative approach was seen to achieve good results and further exploitation of competition was not deemed imperative. It could, however, be devised as an additional format for practising assessments.

1.2 Sequence of Instruction

The learning needs of students change at different stages of skill acquisition, and teachers need to support both integration and generalization of knowledge (Lave, 1991). The progression of activities can have a pivotal impact on the learning process, as the research data revealed regarding increasing complexity and increasing diversity. Additionally, the students' overall grasp of the physical assessment task and its relationship to the nursing process is presented here under the rubric of global before local skills.

A. Increasing Complexity

The novice's sequence of tasks needs to be constructed in such a way that more and more of the skills and concepts necessary for expert performance are required. "Understanding is about making connections among and between things, about deep and not surface knowledge, and about greater complexity, not simplicity" (Perrone, 1994, p. 13).

However, in a study of teachers' pedagogical thoughts, Shavelson and Stern (1981) recognize that because individuals have a limit on the degree of complexity with which they can deal, teachers tend to construct a simplified model of the real situation and then behave

rationally with respect to this version. Hatcher (1983) agrees: "Perception and interpretation of information is selective relative to the goals of an individual who then constructs a simplified model of reality" (p. 6). The author also comments that chunking of information increases processing capacity. This phenomenon was identified by DeGroot in 1965 through studies of differences between ordinary chess players and chess grand masters, and similar results were obtained in a study by Soloway in 1988 of novices and experts doing computer programming (cited in Frederiksen, 1994). "A chunk is also known as a *schema* -- a mental structure that incorporates pieces of information into a single concept that can be used in working memory as though it were a single item" (p. 545).

This aspect was further investigated by Simon (1990), who notes that human rationality is "bounded" by limited short-term memory capacity and the slowness of reactions. Adaptive strategies include problem-solving by recognition, by heuristic search, and by pattern recognition. He defines a "chunk" as "any stimulus that has become familiar, hence recognizable, through experience" (p. 16). He argues that since cognitive performance depends heavily on socially structured and socially acquired knowledge, social variables must be introduced to set the boundaries of our generalizations.

The application of these concepts to think-aloud assessment was reflected in the teacher's log, where the changing expectations for student performances were depicted. At the outset, mere identification of data was applauded by the teacher, but quickly its implications were also demanded and articulation of the resultant nursing care required. The chunking of information was deliberately presented in modeling sessions when the teacher added categories to her articulation, such as "here's another sign of dehydration."

Unfortunately, the mid-semester switch from Pediatrics to Obstetrics countered the design of increasing complexity, in that the cases involving sick children were by their nature much more complicated than the care of generally healthy newborns. A few of the students ventured opinions like the following: "This is sad to say, but I kept wishing that the patient would be maybe more ill, that there would be more things to see that were abnormal." Collins, Brown, and Newman (1989) predict: "We doubt that it is possible to sequence skills and tasks

so they undergo a monotonic increase in complexity" (p. 484). Rather, these authors specify that the significant change is from carrying out subsets of skills to managing overall complex tasks. In this, the students clearly advanced, as shown in their clinical work and written journals, which showed the competence they were developing in analyzing subtle patient data and integrating it into their planning of care.

B. Increasing Diversity

In cognitive apprenticeship, the range of tasks to be attempted by the student should be gradually broadened in order to include a wide variety of strategies and skills. By recognizing and reflecting on these, the student sees the possibilities and limitations of transfer. "A number of studies converge on the conclusion that transfer is enhanced when training involves multiple examples and encourages learners to reflect on the potential for transfer" (Anderson, Reder, & Simon, 1996, p. 7).

In this project the same think-aloud process was repeated again and again, but each situation was unique due to the different patients being examined, the different medical conditions extant, and the different social factors impinging on the physical assessment. In addition, there was the varying composition of the peer group present. These elements all contributed to an increasing diversity of tasks.

Many students commented favourably on the diversity, for example in the following journal entry: "It was particularly interesting to assess the differences in the two babies of two different gestational ages." Another participant said that the patient whom she had assessed the best was memorable because "there were so many things wrong with him, so many deficits." However, the problem noted above in moving from variety-crammed Pediatrics to somewhat homogenous Obstetrics was again reflected in a few comments during the interviews:

Just I wished to have more variety of cases, you know, like because it's not so helpful when you see the same, like full-term baby with the same things almost, with less variation. I have to, I want to have more cases to study.

The students themselves sought diversity, recognizing its power in strengthening their mastery of the process. In the hospital they would request to attend assessments of other students' patients, and this was explained in an interview:

When you saw different children, you got to know a little bit about the case history of the child, and what they're looking for in specific. So you learn a different way, not a different way of doing it but a different angle, different things you're looking for. So I found that interesting.

And a typical comment from an exit questionnaire was: "I would like to continue my training in performing patient assessment, I want to do it for as many as possible different diagnoses and patients." The constraints of the one-semester course were evident, and need to be overcome by repeated practices in a variety of settings.

C. Global Before Local Skills

A significant aspect of traditional apprenticeship is the novice's immersion in the totality of the endeavour, with the final product or outcome clearly in view. Similarly in cognitive apprenticeship, having a mental image of the overall activity helps the student make sense of the subactivity being carried out. While component skills need to be mastered, the complex social setting gives direction to the task. "Unlike Skinnerian shaping, the proposed instructional experience is not broken down into manageable parts, but is kept constant while simplifying the learner's role as much as necessary for it to be manageable by the learner" (Harley, 1993, p. 48). This contributes to the student's development of knowledge: "the difference between command of a fact and knowledge is the ability to relate information to a meaningful framework" (Palincsar, 1989, p. 6). Wood, Bruner and Ross (1976) stress that "comprehension of the solution must precede production" (p. 90), in that the learner needs to recognize a solution to a problem before being able to produce the steps leading to it. An example of this came in the interviews, when a student recalled:

You said to us, "depending on your findings, what kind of nursing care are you going to formulate?" That was new to me too, because normally you do your assessment, you write it down, you analyze it, and then you come up with nursing care. It was on the spot, so it was kind of nice, it makes you feel like you're actually a nurse.

Brown and Duguid (1993) caution that any decomposition of a task must be done with an eye not to the task or the user in isolation, but to the learner's need to situate the task in the context of the overall social practice. The teacher's continuing effort to relate means to ends, by linking the assessment data obtained and the subsequent nursing actions, proved to be necessary. As one student admitted about her previous understanding,

assessment was always just something we do. It never got linked to the rest of the nursing process. Even when you told us about the importance of it at the beginning of the rotation, I thought: "sure" but I didn't understand how really basic it is until now.

Others agreed, stressing that their views had changed:

Before it was just like, I have to do an assessment, just to do an assessment. Now it's like, I'm doing the assessment so I can see if everything is ok and if I can link the problem with something else.

The shift in perception of the global purpose of physical assessment was clearly revealed in the students' written answers to the question: "What would you describe as the main function of the data you gather in assessing a patient?" In the entry questionnaires the responses presented a static view, for example: "Through the assessment we can find out the normalities and abnormalities in a patient." By the time of the exit questionnaires, however, the vast majority of respondents wrote dynamic answers that reflected their grasp of the overall aim, such as: "Gathering data helps to perform nursing actions;" "By checking all details, we can make a nursing diagnosis and determine goals and orders;" "Information on patient helped to know what nursing actions would have to be done." One student even wrote the absolutist statement: "If we don't know or have any data about patient's physical and mental states we cannot perform any nursing actions."

Wilson and Cole (1992) point out that these structural aspects of cognitive apprenticeship (increasing complexity, increasing diversity, and global before local skills) bear a striking resemblance to elaboration theory, which is an instructional design model for sequencing and organizing courses and content developed by Charles Reigeluth in 1978, and they cite successful applications of this approach. Whatever the label affixed to the sequencing strategy, in this think-aloud project it brought about a remarkable change in perspectives amongst the

participants. This was noted not only by the teacher but also by the students themselves: as one student remarked in conclusion, "the bits and pieces I'd learned here and there really came together."

1.3 Content of Instruction

There are a number of types of knowledge required for expertise in addition to the commonly explicated subject matter. Collins, Brown, and Newman (1989) use the term *strategic knowledge* to refer to the usually tacit knowledge involving heuristic strategies, control strategies, and learning strategies. The data analysis shows the ways in which domain knowledge and strategic knowledge were addressed in this project.

A. Domain Knowledge

"Recognition of the importance of domain-specific knowledge took the cognitive psychologist on a first step toward eventual inclusion of social factors as part of cognition" (Levine, Resnick, & Higgins, 1993, p. 586). This move validated the continuing crucial role of disciplinary bodies of knowledge. For example in the field of nursing, many concrete facts must be considered in order to ensure patient safety.

Unfortunately, constructivists often see the teacher's role as one of simply assisting performance and the construction of powerful knowledge and information. To some, ... teaching is a dirty word. They believe it is neither necessary nor desirable (and even harmful) to teach explicitly, provide direct explanation, or require practice. This approach has serious ramifications. (Harris & Graham, 1996, p. 27)

In the hospital settings, the grave and often immediate consequences of incorrect patient assessment allowed no margin for experiential learning unsupported by direct teaching and factual knowledge acquisition. The participants were aware of this and sought to perform safely, and freely asked for assistance or guidance whenever they were unsure. They carefully and thoroughly applied the domain knowledge they possessed. For example, when a newborn was having respiratory difficulty due to blocked nasal passages, the student not only recognized this and performed suctioning, she also considered the ramifications on his sucking ability and the

potential deficit in his nutrition and hydration status, and took preventive action by teaching the parents how to circumvent these complications.

Domain knowledge is an integral part of cognitive apprenticeship, and the teacher's log reported that the students' proficiency in making appropriate comments and realistic plans increased significantly during the course of the semester. In the written reflection sheets a typical remark was: "I definitely feel more competent about patient assessment." In interviews, the students described their own perception of their growth in domain knowledge in clear terms: "I think I had a very big improvement." Another student commented: "When we started and when we finished, of course we were much more skilled following this, obviously, absolutely." Many recalled their initial difficulties, for example, "with the analysis, at first I had a bit of trouble going deeper into why, why it's going on." But all commented on their advancement, saying for instance: "I noticed more towards the end. I looked more for what could possibly be wrong, rather than 'they surfacely look very well,' like I would go beyond that." One student admitted,

In the first assessment that I did, I didn't even know what was normal and abnormal in a baby, for example, or in a patient... Because in the beginning I had no idea... And now, I can go in a room and I can do it myself, you know. It's a big huge difference, yeah!

The students took an active role in acquiring and applying subject matter knowledge. As Bereiter and Scardamalia (1992) affirm, "it takes knowledge to get knowledge, even to know what it is that one needs to know. A system that was all process, that had no knowledge to build on, could never understand anything" (p. 523). The participants attended classes, read the assigned preparatory material in their textbooks, and did follow-up studying whenever necessary. The teacher's log describes the way in which one student assessing a newborn

made a point of "trying out" the gestational age tests discussed in last week's conference. He expressed satisfaction that his resultant age estimate matched the ultrasound age determination when he checked the chart afterwards.

The students utilized their domain knowledge to analyze assessment data and plan nursing care. For example, one reported in the interview about "the baby who was in traction, he had mottled skin. So that could be because of anemia, it could be because he's cold, so I

covered his torso ... and I checked his file for his complete blood count." The weekly journals also revealed this application of assessment data to nursing care. Some representative examples follow:

1. "I did a chest assessment of my patient and heard rales all over the lobes, so I put the head of the bed up so that she would be able to breathe easier and so that the secretions would move."
2. "The mother's blood pressure was low, 102/68... I pushed fluids so her blood volume would increase and thus blood pressure would increase."
3. "Assessment of her nipples led to a teaching action: first I assessed the positioning. It was good. Then I assessed baby's lips on breast. It was wrong. So I taught her with success."
4. "After irrigation of tubing, he began having painful spasms. I gave him half a Belladonna opium suppository to relieve the pain."

The students' competent understanding of the subject matter was evident in this entry:

[The patient] kept scratching herself all over until she looked like she had been attacked by a cat. This is a common side effect of the epidural morphine (which was discontinued six hours earlier). I looked up the protocol with my nurse and we called down to get an order for Benadryl IV. I administered it through a secondary line. Within half an hour the patient felt 100% less itchy.

Clearly, the participants grasped the link between domain knowledge, assessment, and action. For example, one student summarized:

I think the major part is assessment. It's basic, it's measurable, and you know how to do your assessment when you can differentiate between normal data and abnormal data. It's much easier for you to plan your nursing actions and implementation and evaluation and everything.

This student used her think-aloud assessment skills to save her patient's life. Maiorana (1992) affirms that the teaching of critical thinking skills must be integrated with domain knowledge instruction, and stresses that students should be actively involved with manipulating the subject matter. In this student's case, the teacher's log recorded that

her patient was deteriorating post-appendectomy, and we focused heavily on the nursing assessment of his worsening status. She reported her findings and he was taken to surgery for a small bowel obstruction. In discussing this with her later, it was clear that she was impressed by the fact that nothing about her patient had matched the textbook recovery she had expected, and her own openness to assessing his reality had proved to be crucial in getting the appropriate medical and surgical intervention for him.

Although these students still have much to learn, incidents such as the above indicated that their knowledge base was evolving. "Mature clinical judgment is developed through mastery of the assessment process, knowledge of the configuration of that process, comfort with its skills, and familiarity with its language" (Hagopian, Gerrity, & Lynaugh, p. 272). This event also confirmed Gardner's (1991) explanation of the value of apprenticeship: "The test of understanding involves neither repetition of information learned nor performance of practices mastered. Rather it involves the appropriate application of concepts and principles to questions or problems that are newly posed" (p. 117).

B. Heuristic Strategies

"Teachers may assign problems, such as case studies, that require students to think, they may expect students to think, and they may ask them to think, but they do not teach students how to think" (Wales, Nardi & Stager, 1993, p. 186). One of the strengths of cognitive apprenticeship is the emphasis on learning not just a thinking skill but also the subtle ways in which it can be used and the conditions evoking its use. As Marzano and Marzano (1987) declare, "effective contextual thinking ... is a prerequisite to success at any task" (p. 2). The situatedness of nursing students' clinical work offers ample exposure to heuristic strategies, the problem-solving techniques of the domain. However,

instructors often focus on providing factual knowledge and fail to include heuristics and metacognitive strategies. Without these, the learner's ability to apply information in novel situations and solve problems independently is limited. (Browne & Ritchie, 1991, p. 29)

Schoenfeld (1985) has found that one distinction between novices and experts in mathematics is that experts employ heuristic methods, usually acquired tacitly through long

experience, to facilitate their problem solving. In this project some heuristics were conveyed explicitly, as described in the teacher's log entry about a lab session:

Since they had already done the readings on this subject and had heard lectures on it, I elicited their input by identifying the area of the body and asking the students what they would check. As they named things, I showed them the practical manner in which to perform the assessment, concurrently verbalizing my thinking about methods as well as the implications of potential findings. This worked out well as a way of supplementing their theoretical knowledge with my implementation instruction, and it was followed by a brief practice session.

Other "tricks of the trade" were discovered by the students themselves or were suggested to them by the teacher and by each other as they were engaged in task performance related to physical assessment. Mead (cited in Villar, 1994) is credited with developing the concept of symbolic interaction, "the process of trying out practical strategies for achieving success" (p. 5). And Wittgenstein (1958) urged that understanding is enhanced by traversing the same territory in lots of different directions. Thus, repeated and varied attempts by the student under expert guidance should promote learning. Interview responses corroborated that the students saw themselves as becoming more adept: "after you do a few all-over assessments you get maybe a little faster," and "you can see things more quickly than you might have done before." They seemed to generally feel the way one student expressed it, that the think-aloud method had "definitely increased my competence. I was in there, and just **doing** it, and I think I was doing a good job assessing and planning." One participant even claimed that by the end, her head-to-toe assessment "would come automatically then."

The peer group actively shared tips, advice, and assistance. One student gave the example: "For the next person doing it, you could also say 'Ok, don't forget the blue pad on the bed' or whatever" and in conferences they discussed ways of remembering things. A representative comment during the interviews was:

I think as a group it was good to do it with a whole bunch of us around because then we learned from the other people, and I know I remembered so many things I wouldn't have hadn't I seen somebody else do it before. (laughs) And they kind of saved my life a few times, cause oh, those ears! Oops! I always forget the ears! And so that helped.

Donald (1992) counsels that "if we are to promote thinking in our students, our teaching strategies must reflect this intention" (p. 428). Perhaps the ultimate proof of the students' sense of mastery of the thinking skills involved with physical assessment was the declaration by one participant that "I think I could teach somebody else already how to do it!"

C. Control Strategies

Controlling the process of carrying out a task includes cognitive management strategies, or metacognition. Brown (cited in Frederiksen, 1994) defines metacognition as "knowing when you know, knowing what you know, knowing what you need to know, and knowing the need to change your state of knowledge" (p. 546). Even simpler is the way Mason and Santi (1994) put it: "the inner awareness or ability to reflect on what, why, how, when one knows" (p. 6). These authors elaborate that metacognition includes an awareness of one's own thinking, active monitoring of one's cognitive processes, regulation of these processes in relation to the cognitive objects or data on which they bear, and a willingness to exercise the control of one's own thought processes. They affirm that "the metacognitive competence required to develop an argumentative reasoning is modeled, by exercising the alternation of argumentative turns gradually internalized, in a kind of cognitive apprenticeship" (p. 6).

The participants in this project expressed awareness of the impact think-aloud was having on their cognitive processes. A representative remark in the interviews was that this assessment method was "a good way to get us to think things out." They articulated insights such as the following:

It helped me to realize what I was really observing when I looked at a patient. Because when you don't do it out loud, it's going through your mind but you don't realize that it's really going through your mind, you know? It goes so quickly. Of course you look at the patient, you look at the colour, and for the hydration also you look at the lips, but you just look at a patient and you don't realize that you see so many things just from one look. But then from saying it out loud you realize that you are really doing all those things.

Another attested that "I'm realizing more what I'm noticing, what I'm assessing when I'm looking at a patient." One student revealed metacognition in relation to her nursing care plan:

I never thought about it before, but now towards the end I was thinking about it while I was assessing the baby and while I was there. Before it was just, like, after I'm doing it, after I did my whole clinical days, then I'm going to sit down and write it, but it didn't really benefit. It's like of course it benefitted cause this is how I **should** be thinking in clinical but towards the end I was actually thinking like that.

Karpiak (1991) distinguishes diverse ways of knowing, saying that "phenomenological knowledge integrates empiric knowledge and advances beyond it" (p. 128). Marzano and Marzano (1987) stress that students should be made aware of the fact that they can, and indeed must, create meaning for the actions they are engaged in. They maintain that information is processed most efficiently if related to existing cognitive structures; "this requires an initial, subjective engagement with the situation or task at hand. This view is basically phenomenological in nature" (p. 14). As one student agreed,

that's what I learned in this semester: to problem solve, and to think, and to formulate nursing care right there, and **that** is a nursing care plan. Yes. Going back later to sit down and remember everything and analyze it, that's not a nursing care plan, that's an assignment.

Barer-Stein (1991) refers to the process of collecting information, questioning what has been collected, comparing with what is known and selecting what seems important, as the "reflective pause" (p. 43). Intimating awareness of this process, one student declared concerning patient assessment: "We're doing it all the time, but we don't realize! And I think the moment you realize that you are doing it all the time, it's so much easier to do a nursing care plan."

Marzano *et al.* (1988) explain that because experts acquire knowledge through particular mental processes and approaches to investigation, novices need to learn, through content-related instruction in thinking and through instruction in metacognitive strategies, how their study of concepts relates to problems in the real world and to the expansion of their own powers of reflection and action. Consequently, these authors advise content-area specialists to identify the

important schemata, models, metaphors, and modes of investigation in their domains, and to explicitly teach and reinforce these in an integrated fashion with the skills.

Similarly, Donald (1995) urges teachers to identify the most salient concepts underpinning their courses, and to create concept maps which are shared with the students to empower them to think critically. "To develop a model which adequately represents the learning task in any discipline, a grounded or empirical approach which describes the linking of specific subject matter with thought processes must be taken" (Donald, 1992, p. 427). Then the learning task of the student will no longer be to absorb a sufficient amount of information, but to develop the conceptual framework and appropriate intellectual processes within a chosen domain. Martin (1983) cautions that teachers themselves often lack adequate cognitive development and are therefore unprepared to foster it in their students. Nevertheless, Bereiter and Scardamalia (1989) suggest that effort directed toward cognitive goals should itself become a goal of instruction. Costa and Marzano (1987) propose that teachers "articulate metacognition" by modeling their thinking processes aloud and having students describe their own thinking; as the authors declare, "thinking about thinking begets more thinking" (p. 32).

For these reasons, much attention was devoted in this project to explicit articulation of thinking processes, both by the teacher and by the students. In the winter, concept maps for maternal-child nursing were devised and discussed in the clinical conference. In the fall semester, students were given the option of presenting a complete nursing care plan orally to the group rather than writing it in the usual format. The teacher's log records that this was a meaningful experience not only because they presented very well but also because it made obvious the way in which each student had mastered the interconnectedness of data findings and care planning. The presenters demonstrated an overall grasp of the nursing process and how to think it through, and expressed pride in their accomplishment.

The written reflection sheets corroborated the impression of progress in control strategies: "I am now more aware of just how much data I can collect with only one look at my patient." Another wrote that "talk-aloud assessments → thinking process and you recognize abnormalities, and nursing care is easily formulated on the spot."

D. Learning Strategies

Perhaps the most controversial component of cognitive apprenticeship is its view of the learning process: "Learning advances through collaborative social interaction and the social construction of knowledge" (Brown, Collins, & Duguid, 1989, p. 40). The particular ways in which social learning took place in this research project are described in other sections, particularly under the categories of "teaching methods" and "exploitation of cooperation". Significantly, the students recognized these as learning strategies; for example, one student said in the interview:

What aided my learning was having other students there. I found it very helpful because sometimes when you're stumped or when you're missing something, the students can interject and say "Ok, maybe you're looking for this." And it's something that, "Oh yeah, ok, I should have seen that."

Another agreed that peer participation "is extremely helpful because if you forget something, you are reminded. It is a great way to learn how to do proper assessments." This was a point of general consensus, and a typical remark was: "I find that when you do it in front of people you tend to be more thorough, you're more conscientious of what you're doing. Whereas if you're just alone doing it you tend to skip over little things." Others added that teaching each other was a helpful strategy:

When a student had difficulty to assess some point, and you asked another student to do it, it was good too because we recall in our memories something which was like very very deep, and sometimes it was good for it. Always when you teach somebody, it's another method to learn, you know.

Such comments were voiced frequently by the students in an informal manner during the course of the project. As Levine, Resnick, and Higgins (1992) affirm, "individuals learn material better when they expect to teach it to others than when they do not have this expectation" (p. 595).

In addition, the students identified specific strategies which assisted them in their learning task. Many commented on the articulation done in think-aloud, contrasting it with traditional methods:

I've been taught to "go in, do your assessment, come back and tell me your findings." That was ok too, but then you forget stuff that way. And even if you did do it, talking about it later and not on the spot, you might forget to mention that you saw this or you saw that. But talking out loud **there**, chances are you'll cover everything.

Concurring with this, a reflection sheet response was that "what I have learned during the think-aloud sessions stays in my memory without the need of by-heart memorization." One of the reasons given for this was the strong visual component of actually assessing a real patient. Evoking Gardner's (1991) theory of multiple intelligences, a representative comment was: "It's not like I have to remember a sheet, you know, steps. Visually I was there watching it, and hearing it. It makes a difference, than just studying from your paper." Another student interviewed explained that "I'm like, really visual, and I think a lot of people are visual, they have to see things visually, so it really helps a lot doing it that way, the way of assessing." And in a reflection sheet was written: "The think-aloud assessment helped me to remember steps of assessment through visualization."

Another boost to learning was given by the frequent performance of the task and articulation of the thought processes. In the teacher's log was this account: "When I asked [the student] whether my constant repetition of the linkage between assessment and planning of care didn't get too redundant, she exclaimed: 'No, it's great! We **need** that kind of repetition!'" An interviewed student affirmed: "And just the practice, you know, it helps you a lot, because by doing them often you remember more and it becomes easier to do it." In the reflection sheets were the comments: "Repetition, doing and watching, helped to reinforce what was to be learned" and: "The more often I did the assessment the more helpful it became." Unger (1994) points out that "giving students more time invites them to get involved in the kind of thinking that will foster the building of their own understandings" (p. 10). As a response on an entry questionnaire summarized, "I would say experience is the most important thing in learning."

1.4 Teaching Methods

The teaching methods used in this project were adopted directly from the basic tenets of cognitive apprenticeship, and were designed to give students the opportunity to observe and engage in expert strategies in the context of physical assessment. Think-aloud was an important component in each of the following methods: modeling, coaching, scaffolding, articulation, reflection, and exploration.

A. Modeling

"Teachers who want their students to think critically and creatively need to model that same kind of behaviour themselves" (Marzano *et al.*, 1988, p. 31). In cognitive apprenticeship, an expert example of the physical processes of a skill is offered concurrently with an externalization of the usually internal cognitive processes underlying the performance. While doing the task, the model states aloud what he/she is thinking, thus helping the students to begin to integrate **what** occurs with **why** it happens. Brandt, Farmer and Buckmeister (1993) note that this approach is a combination of Bandura's behavioral modeling and Meichenbaum's cognitive modeling: "The goal should be verbalization of thoughts that occur during performance, descriptions of thought processes, summaries of internal speech and what the subject is sensing, and explanations of the reasons for particular types of thinking" (p. 76). These authors point out that "asking first for descriptions and then for explanations helps models to 'tell it like it is' instead of 'telling it like it ought to be'" (p. 76). Choi and Hannafin (1995) refer to modeling as "the cornerstone of cognitive apprenticeships" (p. 61).

In the hospital settings of this project, qualified staff nurses are continuously assessing their patients, but it is not customary for them to explain their thinking to others. Thus it is up to the clinical instructor to model physical assessment for the students. Feuerstein (1978) urges teachers to learn to serve as models for their students, as do Farmer, Buckmaster, and LeGrand (1991): "Professional educators who are trained and experienced as practitioners in the profession can model doing the real thing satisfactorily" (p. 51). The authors point out that the

relevant profession defines acceptable performances, constrained in part by the expectations and regulations of society.

Volet (1991) agrees that students' learning in a particular discipline can be enhanced by modeling metacognitive strategies that underlie expert behaviour in that field, but cautions that while experts often use "proceduralized knowledge" in an automatic fashion, "they have available a rich body of organized knowledge and effective cognitive skills for recognizing meaningful patterns, accessing relevant conceptual knowledge and generating appropriate problem solutions" (p. 320). One of the common problems faced by clinical instructors who are experts in their discipline relates to the fact that after years of experience, their own problem solving processes have gradually become automatized and their knowledge tacit. Therefore,

in order to bridge the gap between their teaching objectives and their students' competencies they need to "decompile" their own expertise and devise ways of facilitating students' development of expert knowledge and skills. Effective strategy instruction requires teachers to teach metacognitively. (p. 320)

To achieve this aim, the teacher in this project fostered a continuous reflection-in-action on the meaning of what was being assessed. The teacher's log depicted in detail the way in which data was explicitly linked to the mental planning of nursing actions. Emphasis was also placed on identifying what information (such as laboratory data) was still missing, following Bereiter and Scardamalia (1989) who used thinking aloud to model not only the solving of problems but also the identification of problems. "When learning is approached within a problem-solving framework, identifying what one does not know becomes a variety of problem-finding" (p. 377).

The log also contained the teacher's confession of apprehension prior to the first modeling task: fears of overlooking an important data item led to fears of appearing incompetent, and thinking aloud raised concerns about sounding less organized and scientific than desired. Consolation was found in the words of Browne and Ritchie (1991), who commend modeling because "by exposing the false starts, dead ends, back-up strategies, and periods of revelation that experts go through, the trainer can help [novices] develop a useful conceptual framework to accelerate their learning" (p. 30).

The initial modeling experience went smoothly and subsequent sessions evoked no insecurities on the part of the teacher. In part this was due to the tremendous positive feedback received from the participants. For example, the student observing that first assessment exclaimed to the group later: "I just think that [the teacher's] methods are terrific! The way she does things, you can't help but learn!" He then launched into a detailed description of the physical assessment he had observed and how fascinating it had been for him. This enthusiasm set the tone for much of the research project, as the students viewed participation as beneficial to their own learning.

When asked at the end of the semester whether the teacher had modeled enough, the students answered affirmatively, and in the questionnaires indicated that it had been helpful. In interviews, their responses were consistently positive, and tended to highlight the sense of order that had been conveyed: "Personally, I found going over it with you the first time, like you did the first assessment in Peds, it gave me an orderly fashion of how I'm supposed to do it, what I'm supposed to be looking for." Another reminisced, "I remember the way you did it and how you went in order, and so therefore I think that will always stay with me. And I think I will use it." One student specified that "helpful was for me when you do the assessment, not maybe once, even twice, you know, when you do it. This was helpful." Others included the frequent peer modeling they had observed, saying that "it was good that when somebody performed you called us to see it and to watch." While the emphasis on modeling does not imply a goal of students' simple imitation of the expert, Schön (1987) points out that imitative reconstruction is a kind of problem solving, in that the novice's process of trying to reproduce the expert's performance creates a new perspective on the task and prompts reflection on the activity.

In addition to the oral modeling, students frequently commented on the power of the visual element as they watched the physical assessment process: "I found it really helped a lot because of the visual aspect, that you could see what was happening and all the input that you got from other people just showing it." Moore (1994) warns that to a novice, many features of an expert model go unnoticed and unappreciated; the same model becomes more meaningful after novices have gained more information about the domain being modeled. This progression

was evident during the course of the semester as students acquired pediatric and obstetric knowledge. Gardner and Boix-Mansilla (1994) caution that although students do need to be immersed in instances of roles characteristic of the discipline and performances practised by proficient individuals,

even the best instances do not suffice. It does not benefit the rookie pianist to hear Arthur Rubinstein or the novice tennis player only to witness Martina Navratilova. Rather, students must encounter individual benchmarks on the trail from novice to expert, as well as road maps of how to get from one milestone to the next. (p. 18)

To facilitate this development, Moore (1994) suggests "activities such as actively attempting to formulate and solve problems can help students reach a stage where the opportunity to observe models results in further learning opportunities" (p. 29). Therefore, rather than making a clean break between the teacher's modeling and the students' performances, the teacher involved the observing students in the initial task. For example, the teacher's log from the first group reported:

When thinking aloud about the patient's traction set-up, I asked [his student] and she supplied the number of kilograms ordered. I repeated this pattern a few times and saw that she clearly enjoyed being in the role of a provider of data. It strikes me that this is an empowering role, and perhaps should be purposefully exploited to underscore the students' knowledge base (i.e. to have them feel that they do know something) before putting them in the position of being the seeker of data in doing their own patient assessments.

This participatory approach was used frequently thereafter. In the early part of the second semester, the log describes:

[The student] nursed her on Thursday, then on Friday morning I took the whole group to the bedside and performed an assessment using the think-aloud approach. I drew her into the process by asking her for basic data about her patient at various times, and rather than leaning over the bed I asked the students on the other side to tell me certain data that they could easily observe there. As we progressed I noticed the students becoming less passive; they asked questions and offered a few tentative comments about things they themselves noticed.

In this manner the modeling segued into the next phase, coaching.

B. Coaching

Schön (1987) contends that "the student cannot be **taught** what he needs to know, but he can be **coached**" (p. 17). Coaching is a term frequently encountered in descriptions of teaching-learning situations, and its particular meaning in the framework of cognitive apprenticeship is summarized by Hamilton and Hamilton's (1992) portrayal of coaching:

1. *Demonstrating task performance by doing the task while the apprentice observes.* While performing the task, the coach directs attention to important features of the task and checks the apprentice's understanding by asking and encouraging questions.
2. *Explaining how to perform a task correctly.* Explanation may accompany demonstration or be provided separately. It sets out performance criteria, points out what problems are likely to occur and identifies possible problem-solving strategies.
3. *Explaining why a task is performed a certain way.* To understand a task, the apprentice needs to know more than the specific steps taken to accomplish the task; she or he also needs to understand the context.
4. *Monitoring and critiquing the apprentice's attempts at the task.* While monitoring the apprentice's performance, the coach gives clear and immediate feedback on initial attempts. Although monitoring and critiquing are continual, the interval between instances increases as the apprentice gains competence.
5. *Modeling problem-solving by thinking aloud and demonstrating problem-solving strategies.* This includes explaining what questions the apprentices can ask themselves when problems arise, identifying the kinds of information needed to find a solution, and pointing out important cues that the coach is relying on to guide problem-solving.

The teacher's log contained numerous depictions of the use of these coaching techniques, for example:

[The student's] eight month old baby actively demonstrated a myriad of developmental milestones, and it was fun to identify them; she knew some, but for many items I guided

the group's observation and interpretation, and when they recognized the milestones they seemed pleased.

In the interviews, think-aloud was evaluated as helpful because "it also gives you an interaction with your teacher where you're not scared to ask questions. It's conducive of questions." A typical response explained:

Always when I wasn't sure of something I think you picked up on it, and you would just come in and give the answer, and like, that was helpful. Ok, you were just right, you know what I mean? You didn't say too much and you gave the students enough time to make their assessments. And I realized that if there was something we weren't picking up on, you would point it out to us. And the way you did it, you would be like, "So what about this?" And you didn't say, "This is it." You'd say, "What about this?" and give the student that opportunity to say, "Yeah, what **about** this?" and to make the assessment and to state their finding.

Choi and Hannafin (1995) describe coaching as directing learner attention, reminding of overlooked steps, providing hints and feedback, challenging and structuring ways to do things, and providing additional tasks or problems. The coach explains activities in terms of learners' understanding and background knowledge, gives directions about how, when, and why to proceed, identifies errors, misconceptions, or faulty reasoning in learners' thinking and helps to correct them. The authors assert that in situated learning environments, advice and guidance help students to make maximum use of their own cognitive resources and knowledge. As Feuerstein (1980) notes,

The prevention of frustration in those students experiencing difficulties, the encouragement of participation, and making the child feel that he is a partner in the process of his redevelopment are among the important elements in the teacher-pupil interaction. (p. 295)

While most participants' responses echoed one student's affirmation that "I think the teacher-student interaction was helpful," there was also a recurring depiction of the teacher's coaching style which raised concerns. It apparently was perceived as insistent, or pushing. Self-confident students claimed to benefit from it, saying in the interview: "When you push, and you're constantly questioning, questioning, I like that. That helps me learn more, helps me start thinking. And if I don't think constantly, then what's the point?" Others felt unease but adapted

to it: "Sometimes I was nervous having you there, if I wasn't sure of myself. But during the actual doing part of it, you would come in and interject and help me out a little bit, so then my nervousness went away." Some expressed ambivalence in response to being asked what they had thought of the coaching:

One thing I liked but didn't like was when you'd always say: "Ok, and what else?" So I'm looking for this, that and the other, I'm trying to stall because I'm trying to think "Ok, what am I missing?" "Ok, what else?" But it makes you think.

However, some participants reacted to the teacher's questioning with panic, as recounted by a student whose newborn patient had an eye discharge:

I know it is normal. And you asked me, "Is it normal, is it normal?" I was going to tell it was normal. And then my brain was thinking all that stuff, you know, infection and all that stuff, and in fact I was scared that if I tell it is normal, oh my God what if it is abnormal? And what's the teacher going to think, that "it is abnormal, she is saying that simply it is normal"? So then my brain started to think about those infection things and I told you that it is abnormal.

Another problematic aspect to the coaching method was the attempted "co-authoring" (Rogoff, 1990) of the assessment findings by the teacher and student, processing the data in what was expected to be harmonious teamwork. This notion proved to be a fallacy as soon as it was attempted. The assessing student to whom the teacher made verbal contributions during the task reacted by becoming flustered and less articulate in her assessment. Afterwards, she explained that the teacher's interjections had "stopped the flow" of her own thinking, and suggested waiting until she had finished and then telling her "where I went wrong." During her exit interview, she said:

I preferred it when you told me after I was finished rather than during, because then it just dried me up completely, when it was during. Well you didn't do it after I told you that it made me nervous.

The sequence requested by her, and adhered to by the teacher henceforth whenever students expressed this preference, was contrary to Schön's (1987) recommendation that

whatever the coach may choose to say, it is important that he say it, for the most part, in the context of the student's **doing**. He must talk to the student while she is in the midst

of a task (and perhaps stuck in it), or is about to begin a new task, or thinks back on a task she has just completed, or rehearses in imagination a task she may perform in the future. (p. 102)

In order to circumvent this problem, the coaching method was modified to include other students whenever possible, which was almost always. The presence of peers proved to have a distinct calming effect on the assessing student, perhaps because the teacher's questions were more diffusely addressed to the group. The coaching then came partly from the other students and was well received. The teacher's log recorded that the next time the flustered student described above assessed, two peers observed and it went smoothly:

Afterwards all three said this had been very helpful and I noted with interest that the two thanked her as if she had offered them something special, and she herself reported that she had felt much more relaxed speaking to her peers and me than to me alone.

A portion of the corrections and feedback still came from the teacher, but peer participation clearly created a buffer effect, softening the impact of the comments on the assessing student's train of thought and sweeping them into the general on-going commentary. The student who had panicked at the teacher's query as to whether the eye discharge was normal made the following remark in an approving tone of voice during her interview:

When the teacher explains it she is going to say all the right things. But when a student is assessing and another student is watching, ... when a student says something and if it's wrong, the teacher is going to explain it, why it is wrong and what is right. So there's two-way learning when a student is assessing.

The traditional view of the teacher as evaluator clearly has a tenacious grip on student perceptions. Crépeau (1995) urges that a clear distinction be made between the role of evaluator and role of teacher: "en situation d'apprentissage, l'élève doit se sentir appuyée, et non évaluée" (p. 23). As the semester progressed the students showed some shifting to seeing the teacher as a collaborator or guide, but only with repeated articulation of this position during conferences, when the teacher would describe the difference between evaluating and teaching. A student's wry response, "but we've never been taught like this before, it is hard to change!" evoked murmurs of assent. This corroborated Wiske's (1994) view that

such activities violate the paradigm that sanctifies knowledge as something the teacher possesses at the beginning, which students acquire during the course, and then demonstrate as their own private possession on a test. To credit students' knowledge, and their capacity to construct and critique knowledge, is to empower students in a way that violates the unspoken norms of most classrooms. Unless this change in the rules of the game is explicitly named and negotiated, students are quite likely to be confused and resistant. (p.21)

Hamilton and Hamilton (1992) add the term "mentoring" to accentuate teaching about social and personal aspects of work (p. 20). The participants' gradual acceptance of the teacher's coaching style may have been related in part to the fact that as they worked together they got to know each other better and understood each other more easily. Discussions of personal views were encouraged. Such rapport seems to be a necessary ingredient in transforming coaching into mentoring. This researcher believes that by the end of each semester, Rogoff's (1990) "guided participation" approach, for the process of giving tacit as well as explicit instruction and engaging in joint problem solving, was achieved due to the close relationships that evolved between teacher and students and amongst the peer group.

C. Scaffolding

Based on Vygotsky's (1978/1933) concept of the zone of proximal development, the term scaffolding was introduced by Wood, Bruner, and Ross (1976) to name the process of creating a supportive structure to promote learning. They underline that learning situated in a social context goes beyond modeling and imitation, as it requires the intervention of a tutor in a scaffolding process. This involvement achieves more than completion of a task, it develops competence by the learner "at a pace that would far outstrip his unassisted efforts" (p. 90). It also provides linkage to previous knowledge: by supporting the integration of established understanding and know-how, scaffolding facilitates the transfer of what students already know to the task at hand (Harley, 1993). For example, one student reminisced:

At the beginning you were there helping us, and saying "well this, this" and "Oh, did you remember to look at this?" or things like that. And then I remember the last time I assessed a baby you were just there, you just were looking at us... It would help because

I would really have to think and then "Oh yeah, it's this, this." So it's good because you let us do it more alone at the end and, you know, gradually, you backed away.

According to Collins (1988), scaffolding ranges from performing an entire task to providing occasional hints. It begins with recruiting the student's interest in a task and demonstrating the act to be performed. Then the expert simplifies the task so that the learner can manage components of the process while maintaining the pursuit of the goal, both in terms of motivation and direction of activity. As Rogoff (1990) says, effective structuring preserves the learner's "involvement with the purpose of the activity, integrating varying aspects of the task in a manageable chunk" (p. 94). Scaffolding marks critical features of discrepancies between the product and the ideal, in order to advance the learner's understanding, with the teacher sharing critical and procedural as well as metacognitive insights (Barta, 1993). The teacher's log revealed that in her think-aloud assessments, a habit quickly developed of noting missing information or mental notes by gesturing with the hand, indicating a "check mark" to remember to find something out. Thus the expert's own cognitive support structure was made visual for the students.

In Barta's (1993) study of scaffolded learning in mathematics, the presence of an experienced and knowledgeable facilitator helped the students remain centred and on task. "Often the teacher's comments simply asked for further explanation or encouraged cooperative participation" (p. 31). In this project, such interjections were frequently made in the course of physical assessments. Barta also recounts that "as the novice gains knowledge and experience, he is assessed a greater responsibility by assuming the role of the expert, now guiding and instructing other novices" (p. 30). Similarly, the students' role in think-aloud evolved from minimal participation to performing complete patient assessments and demonstrating for their peers. The teacher's log reflected this change, for example towards the beginning of the winter term was the following entry:

I did a thorough head-to-toe assessment, maintaining a continuous monologue as I observed and reflected. Gradually the students joined in spontaneously, sometimes with specific questions about the implications of certain symptoms but often with observations of their own.

Continuing in this manner, scaffolding provided a structure that facilitated the students' meaning-making, and was a form of proleptic teaching:

Proleptic means "in anticipation of competence," and in the context of instruction refers to situations where a novice is encouraged to participate in a group activity before she is able to perform unaided, the social context supporting the individual's efforts. In these teaching situations, a novice carries out simple aspects of the task while observing and learning from an expert, who serves as a model for higher level involvement. (Palincsar & Brown, 1984, p. 123)

In contrast, towards the end of the semester the teacher wrote that the students "concentrate on the patient and almost ignore me as they talk their way through the assessment." In the final week students were paired and assigned to assess their infants, with the teacher "giving minimal input and then leaving the nursery, asking them to let me know later on what specific nursing actions they had decided on as a result of the assessment process." As one student summarized in her interview,

In the beginning you were right there, and you were leading the assessment as it should go, like "Ok, this and here when we're in this area," giving me basic guidelines of what we're doing. And as the semester progressed you sort of backed off, in distance and verbally, and it was basically under my control, I guess. Yeah, and it gave me encouragement. Like at the end when you would back away and sort of give me the reins, it made me feel like I knew what I was doing.

Rogoff (1990) uses the term "contingent teaching" to describe the format of less intervention by the teacher when a student succeeds and more intervention when a student fails. She reports that it results in improved performance of cognitive tasks. The ramification for scaffolding is the need for very careful monitoring of each student's progress, in order to provide situations conducive to mastery. Too little challenge will prove boring for the student, while too much will foster frustration and discouragement: "learners will succeed only when learning tasks stretch their ability to an appropriate degree" (Brandt, Farmer, & Buckmeister, 1993, p. 77). Importantly, the students in this project reported feeling supported in their expanding roles: "Whenever I needed you, you were there," said one in the individual interview, and another surmised:

If I needed you I always would tell you that I need you. So you probably feel yourself that at this point, she's already ok, and I appreciate this. So I felt that you specially do this distance right now, you take this distance that you want to give me a chance to do it myself.

Implicit in scaffolding is the process of fading, the gradual reduction of support until students can perform independently (Collins, Brown, & Holum, 1993). In this way students become more self-sufficient and self-regulatory, rather than depending on external structural support (Choi and Hannafin, 1995). Piaget (cited in Flavell, 1963) stressed that the teacher should assist the "internalization and schematization process by getting the student to perform the requisite action with progressively less and less direct support from the external givens" (p. 368). In short, scaffolding can be reduced, reorganized, or eliminated as learners become more complete in their understanding. The teacher's log indicated that the students' competence levels increased sufficiently to safely allow for decreased teacher involvement. The students' own emerging view of their diminished need for assistance was typified by this remark at the end of the semester: "At the beginning we really had no -- well, I shouldn't say we had no clue how to do an assessment, but not as thorough as we do now! Whereas now, we don't need as much help. Hopefully. (chuckles)"

One student complained that when the teacher paired her for an assessment, "It was like tumbling down ... I don't want to put [the other student] down, it was just like as soon as you left, it was suddenly not as important." Dewey (cited in Prawat, 1995) cautioned that

although subject-centred instruction overestimates students' receptivity to canned instruction, activity-oriented instruction underestimates their need for adult guidance, trusting too much the child's own innate capacity to organize or make sense out of individual experience. (p. 15)

However, others rejoiced in the independence-building of the process, reporting about the pairing with a peer that "it worked, it worked!" A helpful step seemed to be the individual and group discussions with the teacher and peers, evaluating the assessment as well as the nursing outcome.

A consequence of scaffolding which was not anticipated by the researcher to be such a strong feature was the definite growth of students' self-confidence as the supports were decreased. Most of the interviews contained references to this, for example: "You would trust me to do my assessment myself, you know. I noticed this... And I was very pleased." Another referred to the fading process and commented: "For me that was a good thing because I felt that I was doing everything up to par." This interpretation of the teacher's diminishing supervision was common: "I think she had a confidence in me and she just let me do things myself and make decisions myself."

The favourable opinion was confirmed in exit questionnaires by statements such as: "Smart how teacher at end no longer joined when we (students) did assessment" and they specified: "It was good timing." They wrote that they had generally felt supported during the scaffolded process: "Also group discussion after each clinical and teacher's assistance while I was doing patient's assessment helped me feel more comfortable and confident with performing it."

D. Articulation

"Talking with one another is a prime medium through which most designing, planning, and learning takes place" (Collen, 1996, p. 54). The Vygotskian view of the role of language in thought and social interaction forms the basis for cognitive apprenticeship's stress on oral discourse. Articulation by the expert has already been described as an essential component of the modeling phase, as students need to hear what the teacher is thinking so that they can access the processes as they are occurring (Loughran, 1994). In addition, articulation by the students is crucial:

In most cognitive apprenticeship experiences, there are three kinds of learner articulation, which occur at different times. Prior to the activity, learners articulate what they plan to do and why. During the activity, they articulate thoughts about the process (unless this interferes with the activity). After the activity, they reflect on and articulate the differences between their performance and the model's performance. The learner's articulation enables the model to monitor their intended performance and provide

assistance as necessary. Articulation also helps learners develop self-monitoring and self-correction skills. (Brandt, Farmer and Buckmeister, 1993, p. 72)

Speaking aloud proved to have advantages and drawbacks. The main features evident from the data are summarized as follows:

1. Benefits of articulation. The participants spoke about their physical assessments before, during, and after performing the task. As expressed in their interviews, they identified numerous benefits, such as "things make more sense to you that way," and "there's something about hearing yourself speak. It's just like when you're doing your readings and you read out loud, as opposed to reading in your head. Hearing your voice, hearing you say something, it sticks." One respondent elaborated as follows:

Saying it out loud reinforces things in my mind. So first when you said it out loud, it gave me a pattern of how I'm supposed to do it. When I did it out loud myself, it reinforced things in my mind. When you're saying something out loud you think of another thing that you should be looking for at the same time, also you can think of what are your nursing actions going to be for this.

A number of students commented on the organization imposed by articulation: "it makes you make sure you get every last detail in there, and not forget anything," and "doing the assessment out loud makes one more thorough." Precision was noted in that "before, I used to feel like I would go around something to get to the point. I would say what I had to say but now I say it more short and it's more precise," and one student explained:

I thought it was very helpful because it's a thinking out loud process, and as you're doing your assessment and you're talking it out, you're going in a systematic order, and it's easier to spot if you've forgotten something, especially if you're going from head to toe.

Participants also remarked that the verbalization assisted their cognitive processes:

You hear yourself speak, and so therefore the data is easier to remember later on when you have to chart it or do a report... When you're writing and you reflect back on the talking out loud process you'll remember at a specific point you said this, and it will come back clearly.

Collins (1988) listed the benefits of articulation as consisting of making tacit knowledge explicit, making knowledge more available to be recruited in other tasks, comparing strategies across contexts, and promoting insight into alternative perspectives. One student described that think-aloud "reinforces what you know and also it increases your knowledge. It does, because you're learning as you go along. Talking out loud was new to me, but it worked for me, it really did." Similarly, Marzano *et al.* (1988) point to the centrality of articulation in the process of making meaning: "Oral discourse may lead to the acquisition of knowledge as well as the application or production of knowledge. Students need to develop an awareness of their inner and outer dialogues as creative processes" (p. 62).

Confirming this view, one student declared that "if you're making an assessment or you're writing up a care plan and you're talking out loud, it will make more sense to you, you'll make less mistakes, and you're aware that you're thinking." Another wrote in the reflection sheet, "stating things out loud reinforces it in my mind and gives me a clearer picture of what's going on. So right away I begin to plan nursing care appropriate to my findings."

While acknowledging that the teacher's presence made them shy at first, all the students agreed that articulation became easier with practice. For example, a student said that "at the beginning I was scared, like, to do an assessment in front of the teacher, but when you do it once, twice, and many times, then it's easy and even with the teacher here." Evaluating her own use of think-aloud by the end of the semester, one said "it was good. It was like, you let us talk and we felt more confident and more relaxed to do this already." Substantiating the monitoring function of think-aloud, a typical remark was:

the teacher is there with you and she's hearing what you're saying, and what you're talking out loud. If you do forget something she can jump in and say "Ok, what about this? Or what about this?" And because you're there on the spot, doing it, and not at the nursing station five minutes later, you still can pick up on it, and it's still there, it's fresh.

The teacher's log corroborated that the students developed ease in articulating, for example: "His verbalizations were fluent, including asking me unhesitatingly about things he observed that he wasn't sure about" and an entry from week 11 of the winter semester reported:

"What pleased me in particular was the automaticity of their verbalizations." Also, a student recounted in the interview a side-benefit she noted:

I was able to speak with the patient because I was used to speaking with you during the assessment, so I was able to incorporate speaking with her and asking questions about how she's feeling, about specific questions. And do it at the same time, and make her feel comfortable, because I was already comfortable doing the assessments.

In addition to conducting their own assessments, the students participated in their peers' performances and discussed each other's cases in group conferences. According to Brown and Campione (1990), underlying the significance of peer learning is the fact that in order to construct an explanation, a learner integrates and elaborates knowledge at a more advanced level. Group discussion thus creates a zone of proximal development in which novices can take on greater responsibility for more expert roles.

In a social constructivist learning community, students should feel free to express their beliefs and to compare them with the other members' beliefs in order to socially construct their understanding. In such a learning setting students can not only hear a problem but rather talk about a problem, being involved in it. (Mason & Santi, 1994, p. 25)

Peer group discussion about an object of knowledge not only develops co-elaboration and co-construction but also opposition and argument, as learners can be required to explain, elaborate, or defend their point of view. "We know from psychologists that explaining your ideas is a pretty good way to improve your own understanding" (Brandt, 1994, p. 26). Mason and Santi (1994) concur: "the argumentation activity can be seen as very close to what is called 'reflective thinking' and involves, from the psychological point of view, the use and strengthening of metacognition" (p. 5). Lively group conferences contributed to this development, and the teacher's log reported active participation and steadily improving verbalization by the students.

A recurring theme which became evident during the interviews was the emotional component of think-aloud. Apparently it contributed in a significant way to many students' self-esteem: "as a student actually speaking it out loud in front of people it really makes you feel more confident." Another described:

My best experience I would say is when you're talking out loud and your clinical adviser is standing next to you, and you say something that's right. It's an overwhelming feeling to hear yourself say something that's right, and to see the teacher respond accordingly. You know, it helps you actually to self-actualize when you hear yourself say something right. Because I, personally, tend to doubt myself a lot, you know what I mean? So even though I might know that that's the right answer, I'm afraid to say it, for fear of getting it wrong. So when you actually do say it out loud and it's right, it's a tremendous feeling.

The same sentiment was expressed in a written reflection sheet: "Think-aloud assessment builds up confidence. There is something about hearing yourself say the right thing that is very therapeutic to progress and growth."

2. Limitations on articulation. Certain restrictions on think-aloud became clear during this project. One concerned the appropriateness of stating aloud sensitive data findings to patients who could comprehend what was being said. In the pediatric setting, the babies and young children enjoyed the attention they received by being the focus of the assessment process, and liked being played with as part of it. The actual content of what was being said was incomprehensible to them and more importantly it was irrelevant to them, as long as the persons involved used pleasant tones and smiled.

With older children, the lack of understanding may persist but they begin to care a lot about what is being said, and would find it distressing to be talked about in medical jargon. With adults, much of what is said by nurses is understood and the problem of discussing assessment findings in front of the patient lies primarily in the alienating effect of doing this -- the patient may feel objectified and treated as a "case" instead of as a person. In the obstetric context, embarrassment and shame could easily be provoked by commenting on the intimate aspects of the private body parts being assessed.

During the pediatric portion of the course, the teacher regulated the use of articulation, ensuring that it was not done in situations where the child would be bothered by it. For example, a log entry recorded: "No think-aloud protocols were conducted on the ward this week because our patients were all older children. Instead, I discussed the students' assessment findings with them afterwards." In another situation a student was instructed to assess silently

and without a group of peers because "her patient was a teenage boy who would have been embarrassed to be discussed by these young women." Other entries reveal further limitations: "the patient was deemed inappropriate for the think-aloud method due to his mother's high anxiety level" and an infant hospitalized for suspected abuse was similarly excluded: "the openly hostile parents were in the room and I did not want to alienate them further by doing a potentially misunderstood inspection of their son."

The students became aware of these constraints, for example in the exit questionnaire one wrote: "Of course there is always the problem if the patient can understand you. It makes things very difficult to be discreet when doing the talk-aloud method." In an interview a student advised discretion with think-aloud, saying "or else you'll just make the patient and the family nervous, and that's not very good." Another commented:

As soon as you start getting with people that can understand what you're saying, or like older people, they know what you're saying, you can't start assessing them out loud because they get nervous, they get scared. So you gotta do it in your head. So it helped a lot with children who didn't know, and babies, to go through every little step.

However, at first this restriction was not universally clear and when the obstetric portion began the teacher's log reported concern, describing how the students eagerly stated aloud all their findings even when assessing the postpartum women. The guidelines for applying this method had to be discussed at length in conferences. Although this aspect improved, one student still "had to be reminded not to tell the mom everything she was looking for, and she kept saying how things 'should' be, an unfortunate phrasing as it creates worry in the patient."

An additional limitation was imposed by the fact that the articulation entailed in think-aloud requires a verbal fluency not necessarily extant. Amongst the eleven participants were recent immigrants from Russia, Ukraine, India, Jamaica and Germany, as well as a young francophone student, who all struggled with the English language and the scientific terminology of nursing. This problem was of serious concern to the researcher at first but quickly it became clear that it was a surmountable obstacle, due to the students' aptitudes and the group's support. The teacher's log had several entries such as: "she struggled to find the correct words to

express herself in English but seemed to know what she was looking for in the baby," and the following was a typical report showing that halting English was not a barrier:

Her young Inuit patient had extensive burns, and she assessed him in a competent manner despite her difficulty with English. She articulated her thinking from observation to action planning. Others joined in, adding aspects to check as well as nursing responses.

Thus, the limitations on articulation did not actually pose any major problems to the implementation of the research project. However, they are important considerations in any use of think-aloud.

E. Reflection

In Loughran's (1995) study of talk-aloud methods, one of his students is quoted as saying: "You do not learn from experience. You learn by reflecting on experience" (p. 24). This echoes Dewey's (1940) view of the relationship between education and experience: he posited reflection as "the heart of intellectual organization and of the disciplined mind" (p. 87). He rejected the notion that the act of thinking is separate from the content of thought, as "reflection mediates the reciprocal interaction between mental and material such that each contributes to the knowledge of the other" (Prawat, 1995, p. 20).

Those who fully understand the thinking process delay action long enough to understand the situation as fully as possible, to consider the end that they hope to achieve, to generate and weigh as many options as they can, and to plan before they take action. Dewey wanted to help students learn to use both the process that includes these steps and the reflective thinking that is characteristic of a professional. (Wales, Nardi, & Stager, 1993, p. 182)

The think-aloud method of patient assessment allows student nurses to take the time to reflect on their findings and consider the implications. Schön (1983, 1987) generated the term "reflection-in-action" to indicate that thinking serves to reshape actions while they are being done. He also described the mutual process that takes place between expert and novice, a coordination of demonstrating and imitating, telling and listening, each component process filling gaps of meaning inherent in the other. "The coach's demonstrations and self-descriptions,

the student's efforts at performance and self-descriptions, the comparisons of process and product, provide material for reciprocal reflection-in-action" (p. 118).

Reflection occurs in three phases in relation to action: it can be anticipatory, contemporaneous, or retrospective (Loughran, 1994, 1995). Participants' opinions of the allotted time for reflection varied. One desired "maybe more discussion time before we did it," but another said in the interview that

there was enough preparation because each week there was a focus. So had you gone to the hospital prepared for that focus there was enough material in that focus to get you through the clinical day, and then to state your learnings for the day, and to have the group discussion.

Another student commented on the anticipatory period, saying:

Already I knew how to approach, and I was prepared a little bit, because you said to us, remember before the day, "we're gonna do next day this." So I was looking again on the two years old development, and what she could do and what she can't do, and I already tried some things to do and I even found those cubes, small cubes, and tried to build this building, the bridge, yes you said the famous bridge one. So it helped me, I knew where to focus.

Contemporaneous reflection was carried out during the assessment task, and took the form of verbalized opinions and speculations as well as concurrent planning of future nursing actions. The teacher's log reported that at first the students tended to merely state their data findings, but gradually followed the teacher's example in including thoughts and feelings in their continuous monologues, reflecting on the data while collecting it.

For retrospective reflection, the teacher's and students' analyses of physical assessments were conducted in the clinical conference setting and involved the peer group in debating the factual points and methodological aspects. In interviews, the prevailing opinion was that "there was lots of debriefing, that was very good" and as one student said: "I never left the discussion afterwards feeling there's something I'm not sure of or should have been talked about. There was always enough time, I never felt pressured." In the exit questionnaires, most indicated that there was "usually" or "always" enough discussion time. The conferences often resulted in proposed further investigation of the domain material, with students reporting their new data the

subsequent day. This continuation contributed to ongoing reflection. McLellan (1993b) asserts that an expert's skillful "postmortem" of the problem-solving process can serve as a focus for reflective comparison and discussion, as can the students' postmortems of their own problem-solving process; another term used is "abstracted replay" to denote a verbal recapitulation of some process designed to focus attention on the critical decisions or actions (p. 42). The participants expressed recognition of the value of reflection; as one student said, "to sit down and discuss it among peers, among students, helped to reinforce it I find."

Reflection can be seen as a number of steps in thinking which, when organized and linked, lead to a consequence in action, a "reflective cycle" (Loughran, 1995, p. 4). This view is elaborated by Jones, Palincsar, Ogle, and Carr (1987):

Thinking is neither continuous nor linear. That is, the model learner may stop thinking at any time to reflect on the process of learning, the relationship among ideas and information in different parts of a text or data base, or the linkages between new information and prior knowledge. (p. 22)

These authors add that the learner may return to earlier hypotheses to confirm or reject them as well as test new information against previously held beliefs or prior knowledge; "in fact, the learner may use sets of strategies in variable sequences or in iterative cycles" (p. 22). An example of a reflective cycle can be recognized in the following excerpt from the teacher's log:

Her patient was shy with us, so we kept physical assessment to a minimum and emphasized developmental aspects, by watching [the student] play with her and making suggestions for developmental items to assess. Then we obtained further data from the mother who was present throughout. Separately, we then discussed how to structure nursing care to actively promote the child's development. In reflecting on the experience in conference later, what seemed to impress the group was the realization that assessment itself can be a therapeutic intervention!

Geltner (1993) portrays reflective practice as making explicit what practitioners often do not talk about, permitting the unconscious thoughts, assumptions and patterns that guide actions to be raised to a conscious level. This facilitates the articulation of how knowledge, thought and action are integrated, and promotes dialogue among practitioners and the sharing of experiences

with novices. Orey and Nelson (1994) point to studies of practitioners in a variety of domains which reveal practices that alternate between situated action and reflection-in-action. They propose that if such behaviour is characteristic of experts, it may be advantageous to encourage learners to adopt similar behaviour when learning to solve problems. Another excerpt from the log revealed:

I have also made a point of articulating my own learnings at the end of each day just as they are asked to do in the group conference. I believe this has helped them to be less afraid of not knowing something, since there is always a way of remedying it. Hopefully it has also shown them that the learning process never ends.

Supporting this, Wiske (1994) says that "teachers who learn model the development of understanding and create a reciprocal relationship with students that legitimates their own struggles to learn" (p. 21).

However, McAlpine, Frew, and Lucas (1991) lament that the discontinuous nature of much professional pre-service training has made the professional way of knowing tacit at best and, at worst, inaccessible to the novice. They affirm the need for explicit opportunities for intentional reflection, such as the use of journals;

what is required is a means of enabling becoming practitioners to overcome the limitations of the training experience: compressed time in which to master knowledge and skills; limited occasion to operate in the real and complex reality of the professional world; resulting loss of opportunity to create an integrated coherent professional way of knowing. (p. 69)

A similar concern is discussed by Kramp and Humphreys (1993), who use student essays and videotapes to promote reflection and self-assessment. Another format is presented by Collen (1996), who encourages a focused group discussion as a reflective activity.

In addition to holding discussions at the end of every clinical day, the students in this project wrote weekly journals, which forced them to deliberately reflect retrospectively on their experiences. While many journal entries were straightforward reports of events, others showed reflection-on-action that led the students to consider alternative interventions:

The doctor explained to the patient that he will need a bladder catheter (foley) post-op. Patient didn't understand it. I did some teaching -- I brought a foley to him to show what is it and explained how does it work. I didn't have time to find a picture. It would be even better if he saw a picture.

Their writing also indicated anticipation of future actions, for example: "My patient did not have a bowel movement for two days. I assessed the bowel sounds and reported to the RN. My next action would be increased fluid intake and high fiber diet." Another student prevented complications: "One of the side effects of this med is constipation. So I provided her with Colace."

Collins, Brown, and Newman (1989) recognize that complex cognitive activities involve some version of both generative and evaluative processes, which can be difficult to learn in tandem. "Thus, cognitive apprenticeship involves the development and externalization of a producer-critic dialogue that students can gradually internalize" (p. 458). They suggest this be accomplished through discussion, alternation of teacher and learner roles, and group problem-solving. Similarly, Brandt, Farmer and Buckmeister (1993) note that reflection is facilitated by discussion, alternation of model and learner activities, and learner problem-solving under guidance. Scardamalia and Bereiter (1983) developed a technique of "co-investigation", in which students think aloud as they carry out a task; the instructor then proposes that together they examine the thinking, which teaches the students how to reflect on their thinking.

In cognitive apprenticeship, novices compare their performances and engage in joint and individual reflection on their strengths and weaknesses. These were the tactics employed in this research, and the responses were favourable: "I found it very helpful" was the most commonly heard response when students were asked their opinion of the think-aloud method, qualified by additions such as: "I am using it, but I wish I could have used it before" and "it should be at the beginning," and repeatedly: "I learned a lot from it."

F. Exploration

The exploration stage provides the opportunity for experiential feedback and forces students into exploring modes of problem solving on their own (National Council on Vocational

Education, 1991). Rogoff (1991) maintains that it is guided participation which leads to learners' development of skilled processes for their later independent performance, and according to Geltner (1993), cognitive apprenticeship seeks to produce superior capacities for knowledge application, transfer and use in the solving of real problems of practice.

Towards the end of each semester, the teacher withdrew some of the supports for students' problem solving and also problem setting, a fading which encouraged the participants to explore the domain on their own initiative. In discussing whether they expected to apply their assessment skills in other clinical areas, a number of interesting commonalities emerged, among which the following three stood out the most:

1. The students had completely appropriated the notion of the basic need for assessing their patients, stated in the interviews as: "We still have to do a head-to-toe with any patient, so it goes from place to place" and "when I go to med-surg, it's a different approach, but still I'm going to remember about assessment, to check everything, you know, from the head to the toe." As a typical response in the written reflection sheet affirmed, "even though I will not always talk aloud depending on the situation, the process that was developed will continue: thinking and gathering information in a systematic order." Another interviewed student pointed out that she had transferred her skills in assessing children to her assessment of adult patients: "I found that it pulled through, the assessment on the infants that we were doing out loud, it pulled through to my assessments on the mom... and I was assessing more." These responses are in line with Booker's (1984) view of Feuerstein's constructs:

Wide applicability of strategies increases student's awareness of integrated knowledge bases and fosters a sense of relationships across all learning (transcendence). These understandings can do much to reduce an episodic grasp of reality, the inability to see and to apply related knowledge, evidenced by so many undergraduates. (p. 15)

2. The participants remarked on the role of self-confidence in transferring these skills. As one student phrased it, "basically it's the confidence that can be transferred. Because you have the confidence doing it with children, so you're not nervous about it" and another assured that "I think that I am so confident in that, because the same thing is going to apply for an adult

patient, the head-to-toe, so I think I'm going to really be ok in the next." Only one student was unsure, saying "I don't know, once I work with adults again, if it [physical assessment] will change a little bit cause it's much more intimidating to work on a bigger person than a little person. But I'll try very hard to keep it." The teacher's log noted that as the students entered unknown situations in the course of the semester, they displayed increasing ease as they applied their assessment skills to a variety of patients.

3. The students surprised the researcher by announcing that they did not perceive the modification of verbal articulation to silent thought as being problematic. According to the exit questionnaire, the majority had already transferred think-aloud skills to silent assessments, described as: "I was saying it in my mind." As was elaborated in an interview,

You're talking out loud but not out loud, in your mind. So if you're doing a head-to-toe and you're going in the same order and you're going, "What about this? And what about this?" You're doing the same thing but you're not talking it out loud. It's like a training that your mind goes through. After you've done a few talking-out-louds, you can do it silently. Your mind is trained to do it. And I found that that was true for me.

Many others duplicated this view, using similar phraseology, for example: "I think I was doing it anyhow, in my head. Especially taking vital signs, you can look at a lot, cause you've got that little pause when you're doing respirations, you can check all kinds of stuff" and another said:

I know that not all situations you could talk out loud, it depends on the situation. But also, instead of talking out loud it's like you're talking out loud in your mind, but you're doing the same process and you're following the same steps.

These declarations offer strong evidence of the students' progress along Vygotsky's continuum of social speech to private and to silent speech. Their process of first articulating thoughts and then internalizing the spoken words into a changed pattern of thinking is proof of the assertion that "speaking to oneself or to others actually shapes process and beliefs" (Marzano *et al.*, 1988, p. 62). For example, one student gave this application of think-aloud:

It helps later on when you're doing it in your head, so that you can do it, like, aloud but so no one else hears (laughs). Yeah, like if I'm going from head-to-toe then "ok, so now I'm going to look here, now I'm going to look there, and this is doing well, and oh-oh,

look over here", and I do it all in my head. As if there's someone standing there listening to me.

Thus, the students' transfer of their vocalized physical assessment skills to silent assessments in other clinical areas seems certain; one student stated that "even if I don't do it out loud it would help me. I would like to do it out loud again, if I would have a chance. But if I don't, I would think about it, definitely" and another affirmed: "it's something that you carry on, for sure." Feuerstein's (1980) concept of mediated learning pertains, in his view that the aim of teaching is for the student to become an autonomous learner with an internalized need to learn. This goal transcends by far the limited milestones relating to the individual's academic achievement and professional status; rather, it aims for "an increase in freedom and alternatives offered to, and perceived by, the individual for his self-realization and the materialization of his culturally and personally determined needs and aspirations" (p. 385).

Furthermore, it is impossible to limit the exploration phase to the mere performance of tasks, as "constructivist epistemological considerations lead directly to the important issue of social empowerment" (Harding, 1993, p. 54). The author declares that in a society that is stratified by race, ethnicity, class, gender, sexuality, or other politics, those at the top organize and set limits on what activities can be engaged in and what persons can understand about themselves and the world around them. Welker (1992) concurs, accusing that knowledge can be used as a form of social control -- one way of positing a certain understanding of the world and preventing students from either questioning that view or exploring their own personal life histories.

To counteract this danger, the participants were encouraged to constantly relate their clinical learning to their own experiences. The teacher's log indicated much conference time dedicated to discussing their points of view and their questioning of assumed truths. As one student exclaimed, "I never thought about children in this way before!" Others commented that the experience was forcing them to reexamine their own value structure and relate it to their incipient self-concept as nurses.

Bolotov and Spiro (1995) assert that in order to change from traditional roles, both teachers and students must be free to see the world from multiple perspectives, to recognize the assumptions with which they view the world, to question those assumptions, and consequently to develop new perspectives. Hay (1994) states that "rationality is used to strengthen the relative merit of the dominant tradition, while at the same time masking the fact that it is a tradition" (p. 25). He says that what educators and students must confront is the fact of having inherited an entire array of information and judgments that inscribe differential power relationships; therefore, students must develop a critical understanding of traditions so that they can know when to utilize them and when to discard them. The nursing care of infants and children places students in a strategic position for examining the myriad social factors impinging on individuals and families. Towards the end of the project, the teacher's log mused on the subject in a different way:

Empowerment: this is really the crux of it all. I link it directly to understanding the connection between patient assessment and nursing care, i.e. what we observe in our patient gets analyzed and leads to specific nursing interventions. Very many students treat assessment as just another job to be done, one among many unrelated tasks to be performed for the patient. In contrast, when one assesses something and consciously formulates an action plan based on the finding, and implements the plan and then assesses the effect of the intervention, it produces a feeling of power. There is internal coherence in our nursing actions and we can make a difference! This very basic concept may sound elementary but it can take years to be mastered... This clinical group appears to be well on the way towards the goal.

Freire (1970) takes this concept a step further, identifying the "praxis" of naming the reality around us, reflecting on it and acting on it, thereby transforming it:

Education either functions as an instrument which is used to facilitate the integration of the younger generation into the logic of the present system and bring about conformity to it, or it becomes the practice of freedom, the means by which men and women deal critically and creatively with reality and discover how to participate in the transformation of their world. The development of an educational methodology that facilitates this process will inevitably lead to tension and conflict within our society. (p. 15)

To bring students to this stage of exploring their understanding in social context is the ultimate aim of cognitive apprenticeship, and the project undertaken here was merely a small

step in that direction. Nevertheless, the combination of analytical perception developed by the students, the habit of reflection which was begun, and the self-confidence they displayed in devising and implementing appropriate actions, suggests that transformation of their own thinking is already creating change in the world around them. For example, in the journal section usually dedicated to **physical** assessments and nursing interventions, a student wrote about her patient who had just given birth:

This may sound like a strange example, but I think it's a very important one. When the lady came about the baby pictures, she was really pressuring mum to buy and was speaking very condescendingly to mum. Said she had to make up her mind now, and was very rude. She said she needed to get home and could not waste her whole day here. Mum got really flustered and weepy. So I stepped in and told this lady she would just have to come back tomorrow. The lady seemed really surprised but did what I told her. I took the role of patient advocate. Mum looked really relieved after the lady left.

The satisfaction implied in her final sentences meshes with the comments made in clinical conferences, when the students reported that they were applying the assessment approach to various situations encountered, including social settings outside of the hospital. The consciousness of engaging in praxis seemed to entail a certain amount of pride and augment their self-confidence.

Since completing the semester, one participant has experienced another "exploration" experience which she described in detail. A crying infant had been taken to the hospital Emergency Room but was sent home without a diagnosis and without treatment. The worried parents brought the baby to this nursing student, who says she proceeded to do a "think-aloud assessment for myself" and localized the site of the problem as the infant's thigh. When she then accompanied the baby to the hospital and vehemently insisted on radiographic examination, a fractured femur was detected. Treatment ensued and because of the history of the injury's origin at a daycare, the student was involved in court testimony to clear the parents of child abuse charges. Assessment had progressed to action -- as Marx (1978/1845) said, "the philosophers have only interpreted the world in various ways; the point is to change it" (p. 98).

2. Identification of Themes Emerging from the Data

As the collected material was read and re-read by this researcher, certain themes took shape and found substantiation by repetition and variations. In general, the positive impression formed via the previous method was substantiated. As there was much overlap of the emerging themes with the characteristics of the learning environment already described, repetition will be avoided by summarizing concisely the highlights of the results of the second method rather than giving a detailed account. Brevity is also served by not restating the supporting data found in oral and written quotations. Rather, the following descriptions and tables present the major recurring elements identified in the data, summarized under the categories of affective factors, teaching/learning strategies, and performance outcomes. A comparison of students' responses on the entry and exit questionnaires is also shown in graphic form.

2.1 Affective Factors

Present in all the data sources was evidence of the teacher's and students' sense of enjoyment of think-aloud and the satisfaction derived from its use, even if certain stresses were unavoidable. Of particular interest was the students' strong affirmation of increased self-confidence. This term was used to indicate feeling at ease with the procedure, having a sense of certainty that the task was being carried out correctly, and feeling sure of being able to tackle future assessments. These affective components are presented in Table 1.

Table 1

Affective factors in think-aloud physical assessments

Theme	Source	Findings
Enjoyment of method	Interviews, Group Discussions Teacher's Log	Participants reported enjoying the use of think-aloud for physical assessments, noting that this approach was a new experience for them. Modeling and coaching were described as "fun" tasks by the teacher.
Satisfaction with method	Interviews Teacher's Log Reflection Sheets and Exit Questionnaires	Respondents said they felt that they had benefitted greatly from learning physical assessment in this manner and felt they had done a good job. Seeing the students' sustained interest in think-aloud contributed to teacher's sense of satisfaction. Unanimous assertions of students' strongly positive evaluation of think-aloud and commendations for its use.
Stress of method	Interviews Teacher's Log	Initial shyness about thinking aloud reported to have resolved itself easily. Time constraints and complex nursing tasks meant much teacher effort was required to fit the time for think-aloud assessments into students' on-going clinical work.
Increased self-confidence	Interviews Journals, Reflection Sheets, Exit Questionnaires	Every participant expressed feeling significantly more self-confident in performing physical assessment and attributed this change to think-aloud and the numerous instances of practice. The written documents contained many comments emphasizing the increase in self-confidence experienced by the students.

2.2 Teaching/Learning Strategies

The participants reported valuing certain strategies used in connection with the think-aloud approach, naming most frequently the role of articulation in helping them to clarify and reinforce information, recall data and become aware of what they were observing. The teacher noted that they spontaneously compared and contrasted viewpoints and became increasingly at ease with thinking out loud. Modeling and scaffolding, identified by students as "being shown how to do it" and "the teacher backing off and having us do more stuff", respectively, were also valued. The coaching style was perceived in different ways, as discussed earlier, which shows that it needs modifications in order to make it more universally acceptable. Reflection was presented by the teacher as an on-going part of the process and came to be viewed by the students as an integral aspect of think-aloud. The helpfulness of peer presence was a recurring theme in every interview and in most documents, as indicated in Table 2.

2.3 Performance Outcomes

Although the study was not designed primarily to evaluate changes in students' skill levels, acknowledging such changes was part of understanding the impact of the use of think-aloud. This estimation was based on the students' self-reports in interviews, as well as the teacher's

- a) observation of their bedside performance of assessment;
- b) critical review of their written and oral nursing care plans as presented in journals and group conferences;
- c) scrutiny of the actual nursing care implemented by the students.

The findings are summarized in Table 3, and indicate a substantial improvement in performing physical assessment skills and in grasping the overall nursing process, especially the relationship of the assessment step to the other facets of the nursing process. The data also suggested an increase in metacognitive abilities, as the students verbalized awareness of their thinking processes.

Table 2

Teaching/learning strategies in think-aloud physical assessments

Theme	Source	Findings
Value of peer presence	Interviews, Discussions, Reflection Sheets, Exit Questionnaires, Teacher's Log	Unanimous opinion that having peers present and involved in think-aloud assessment was very helpful. The observed student felt supported by peers, and the observing students learned from watching, participating, and reflecting on this experience.
Value of articulation	Interviews Teacher's Log	Assessing out loud was credited with improving thoroughness and competence, as well as a new awareness of thinking. Participants were hesitant at first but became fluent in articulating their thoughts. This revealed data observations, the way in which these were processed, and the creation of nursing care plans. Patients who could not be assessed out loud were examined silently, followed by teacher-student discussion; direct think-aloud was preferred.
Value of modeling	Interviews	Both the teacher's and peers' demonstrations of think-aloud were reported to have been beneficial to the observers.
Perceptions of coaching style	Interviews	Some students felt comfortable with the teacher's coaching style, others felt pushed too persistently by the teacher's questioning.
Interpretation of scaffolding	Interviews Teacher's Log	All respondents noticed the teacher's fading and had interpreted it as approval of their performance, which in turn increased their self-confidence. Careful fading by teacher, noted to result in the students' assumption of increasing responsibility.
Reflection	Journals, Interviews, Discussions, Teacher's Log	Discussing the assessment to be done, thinking aloud during the task, and analyzing it afterwards were perceived to be helpful aspects to learning physical assessment.

Table 3
Performance outcomes in think-aloud physical assessment

Theme	Source	Findings
Improved assessment skills	Interviews, Reflection Sheets, Exit Questionnaires Teacher's Log	Participants reported that their competence in performing physical assessment had improved, and attributed this to think-aloud and frequent practice. Recorded observations revealed an overall improvement in students' data collection, data analysis, data prioritization, and data recall.
Improved grasp of the nursing process	Interviews Journals, Teacher's Log	Respondents affirmed that the coherent flow of the nursing process had become clearer to them as a result of verbalizing their patient's physical assessment data and thinking out loud as they planned consequent nursing actions. Students' planning and implementation of responses to assessment data became increasingly appropriate and complex. Gradually their plans for nursing care included consideration of preventative and alternative actions.
Metacognition	Interviews and Group Discussions	The majority of participants stated that by the end of the semester they had already transferred their think-aloud assessment skills to silent assessment procedures. The remainder said that they expected to do so in the next clinical setting. All professed heightened awareness of their own cognitive processes.

2.4 Comparison of Entry and Exit Questionnaires

Responses to the entry questionnaire (Appendix H) yielded helpful information about the students' previous experiences, which was used to support the process of indexing their new learning to earlier knowledge. The exit questionnaire answers (Appendix I) provided interesting confirmation of the changes perceived by the students after a semester of think-aloud. For example, in defining the main function of assessment data, only one entry respondent suggested a link to nursing action; the other five all gave static, information-oriented views, such as: "To complete a picture of the present health state of the patient." In contrast, in the exit questionnaire four out of six specified the link of the data to planning nursing care, showing the development of a more dynamic integrated view.

A certain increase in self-confidence was identified, as shown in Figure 1, which presents numerically the students' responses to the question: "Do you feel comfortable in performing a patient assessment?" The respondents also reported a perception of an improvement in their physical assessment skills; their responses to the question: "Do you feel competent in performing a patient assessment?" are indicated in Figure 2.

Figure 1

Responses to the question:

"Do you feel comfortable in performing a patient assessment?"

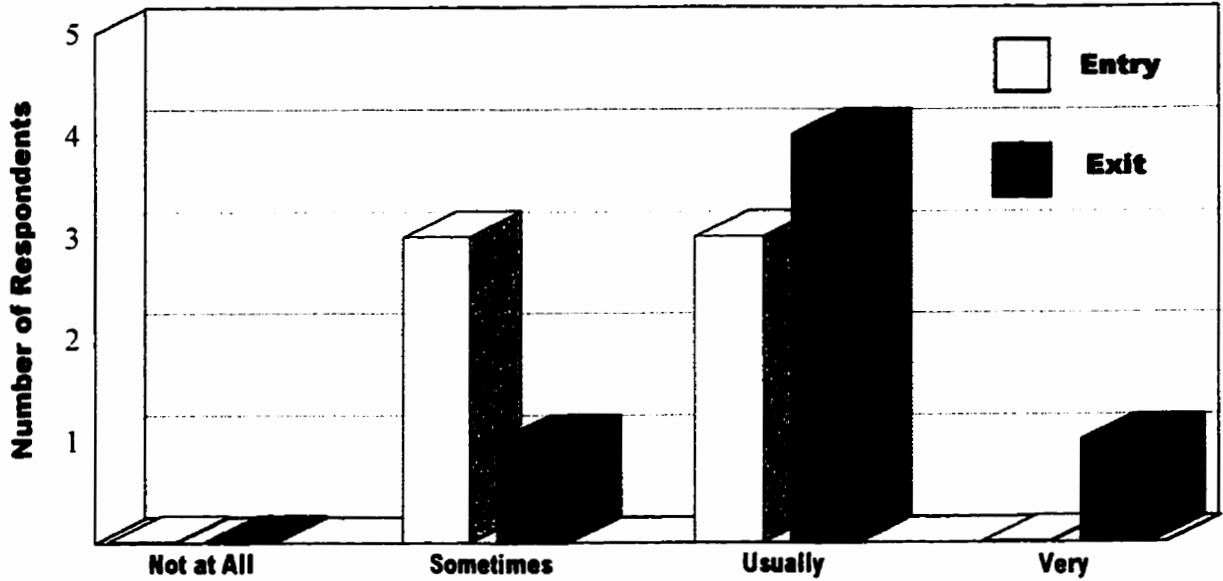
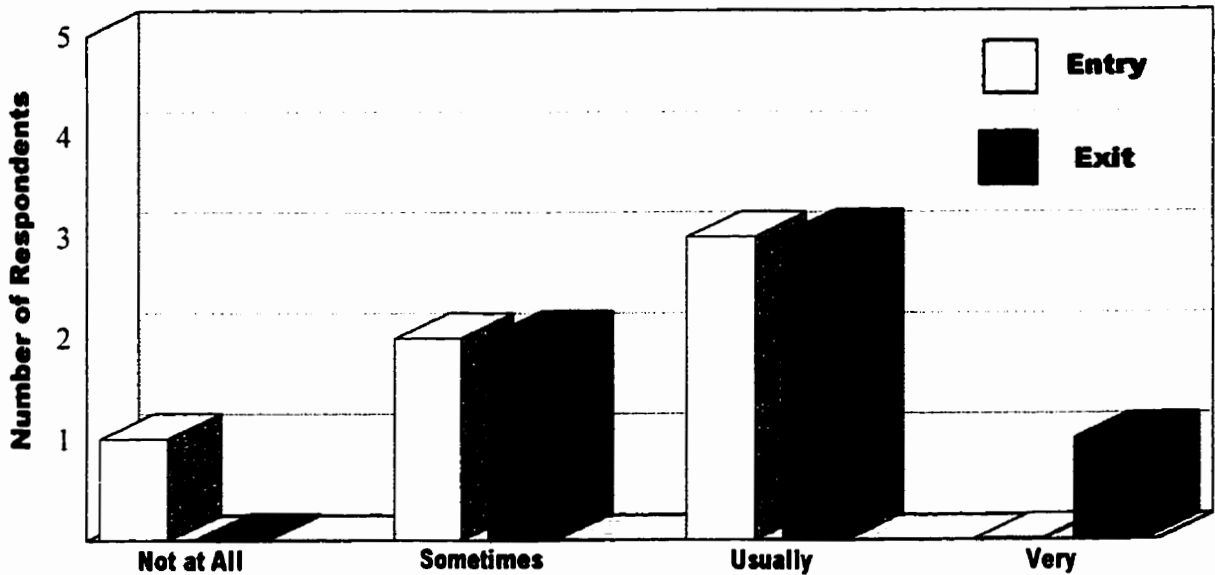


Figure 2

Responses to the question:

"Do you feel competent in performing a patient assessment?"



CHAPTER V

CONCLUSION

In examining the use of think-aloud for teaching physical assessment skills to nursing students, analysis of the results showed that the research objectives had been met. As stated on page 25 of this report, the original intent had been to identify if and to what extent the use of think-aloud contributes to the creation of a positive learning environment, to apply the data in concrete situations, and to describe and understand the use of think-aloud. The results showed that think-aloud contributed favourably in each of the areas identified by Collins, Brown, and Newman (1989) as characteristics of cognitive apprenticeship, with the exception of "exploiting competition". While recognizing that competition has its place, it was not the focus in this project and its employ was not attempted. This caveat notwithstanding, the think-aloud method had been successful in creating a productive and supportive learning environment. It is hoped that the data presented in this report "provided a picture of the process of implementing the cognitive apprentice method of instruction, a holistic impression of the method as it was used" (Johnson & Fischbach, 1992, p. 18). From the evidence gathered, certain reflections are prompted and a number of recommendations will be offered.

1. Reflections

First, think-aloud and the cognitive apprenticeship experience clearly changed the students' perspectives on physical assessment. Marzano and Marzano (1987) outline the parameters of a mental set to consist of affect, attitudes, focus, and meaning. In this project, think-aloud obviously had an impact on the students' mental sets, as according to their self-reports it involved intense emotions and attitudinal changes, produced visible attention to the task and in discussions linked new knowledge to previously held concepts.

Second, the data indicates that the students experienced an increase in self-confidence and enjoyed the think-aloud process, as shown by their sustained eagerness to participate and by their spontaneous expressions of appreciation of the approach. If they perceive assessment as

not only an important task but also an enjoyable one, it can be surmised that they will include it in their nursing care more consistently than a person with negative associations might. As identified by Volet (1991),

through guided learning, students are more likely to develop positive attitudes towards their learning because of the strong social support and because the potential power of the content-based thinking strategies that are taught is demonstrated and of immediate relevance.... A teaching-learning approach that students themselves recognize as effective and enjoyable is likely to produce better results and is more likely to be successful than one that encounters students' reticence, dislike or doubt about its effectiveness. (p. 321-322)

Third, the evolving praxis with its changing emphases offered an example of the dynamic nature of action research: "participation itself changes the understanding of a task" (Rogoff, 1991). In addition, it demonstrated the tensions inherent in implementing new pedagogical methods. As Weinbaum and Rogers (1995) recognize, "putting a pedagogy of understanding into practice requires a fundamental renegotiation of intellectual authority" (p. 21), or to quote Marx (1978/1845), "the educator must himself be educated" (p. 97). In a study by Presseisen and Kozulin (1992) of a Feuerstein-based mediated learning program, teachers who had participated reported that they saw their pupils in a new light, displaying increased motivation, spontaneity, and engagement in learning. The authors query: "Had the students changed and/or the teachers?" (p. 31) Similarly, in the course of this project changes occurred not only in the students but also in the teacher's own perception of the role of a coach in cognitive apprenticeship, and much personal satisfaction was recorded in the log as the think-aloud approach evolved. The project achieved what Reason (1994) poses as the primary outcome of participatory action research: "a change in the lived experience of those involved in the inquiry" (p. 333).

Fourth, the importance of peer support became evident to all participants and the teacher-researcher. Rather than being viewed as merely an interesting adjunct, this proof of the value of cooperation was acknowledged as a central finding of the project. This realisation, supported consistently by the data collected throughout the project, means that peer cooperation needs to have a prominent focus in any future applications of think-aloud.

Fifth, the participants made substantial progress in their mastery of physical assessment skills and their grasp of the nursing process. This cannot be attributed solely to the think-aloud method; after all, "a situated approach contests the assumption that learning is a response to teaching" (Brown & Duguid, 1993, p. 10). And Rogoff (1990) points out that

most research on the effects of a particular variable requires that other variables be held constant, but with questions of the impact of sociocultural experience, it is impossible to exert such control over the phenomenon without destroying it... The particular actions and skills of an individual cannot be understood out of the context of the immediate practical goals being sought and the enveloping sociocultural goals into which they fit. (p. 139)

Similarly in this project, student performance outcomes can only be evaluated as a response to their entire semester's class and clinical experience. Nevertheless, the students' responses in interviews and written documents revealed that they perceived think-aloud as providing them with a method and a setting in which their skills could flourish.

And sixth, despite the limitations on use of think-aloud imposed by the social constraints of articulating physical assessment, the students were able to maximize the opportunities for practicing think-aloud and even progressed to its application in silent procedures. The participants maintained that their experience with think-aloud was helpful to them in transferring the acquired assessment skills to applications with adult patients, and expressed the expectation of using these skills in other clinical areas. Further practice in conducting physical assessments will expand their proficiency; as Hagopian *et al.* (1990) comment, sufficient opportunity for assessment practice in real patient care situations is a key factor in the "full development of clinical decision making skills" (p. 272).

2. Recommendations

Based on the data analysis presented and the conclusions drawn from it, the following recommendations are offered.

1. Possible use of the think-aloud method for teaching physical assessment needs to be investigated in a variety of fields of nursing beyond the pediatric and obstetric clinical settings.

This will reveal domain-specific modifications needed and will strengthen the soundness of the method.

2. Think-aloud should be implemented by numerous nursing instructors with different manners and personalities, in order to identify which aspects of the teaching methods prominent in cognitive apprenticeship are inherently problematic and which ones can be overcome by changes in coaching styles. This will require training of instructors who are willing to try something new.

3. The nursing curriculum at the CEGEP level could be expanded to allow for group and individual reflection on the students' lived experience of physical assessment to support their developing assessment skills. This could take place in clinical conferences or in the college classrooms.

4. Laboratory practice sessions would be made more useful to the students by including think-aloud physical assessments. The teacher's modeling and the students' practicing could be done using mannequins, fellow students, or actor-simulated patients.

5. Further research into applications of think-aloud should be conducted and evaluated. As Berryman (1991) writes about cognitive apprenticeship,

the ideas are unusually well-grounded.... However, there are very few learning situations that reflect cognitive apprenticeship principles. Extending the ones that exist and creating new ones requires dealing with regulatory, institutional, curricular, pedagogic, assessment, and professional training issues. The model itself will change as we gain experience with it in the bruising real world of teaching and learning. (p. 5)

Finally, although the immediate audience for this research is the University of Sherbrooke for fulfillment of the requirements for a Master's of Arts in Education degree, a subsequent step will be for this researcher to address the nursing education community via professional journals. Perhaps this will spark interest in using the think-aloud method or other applications of cognitive apprenticeship theory. It is hoped that the expanded use of think-aloud will serve to transform students' physical assessments of their patients into a solid foundation for the nursing process, and thus to improve the quality of nursing care.

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APPENDIX A**"CHARACTERISTICS OF IDEAL LEARNING ENVIRONMENTS"**

(from Collins, Brown, & Newman, 1989)

I. Sociology

- a. situated learning
- b. culture of expert practice
- c. intrinsic motivation
- d. exploiting cooperation
- e. exploiting competition

II. Sequence

- a. global before local skills
- b. increasing complexity
- c. increasing diversity

III. Content

- a. domain knowledge
- b. heuristic strategies
- c. control strategies
- d. learning strategies

IV. Methods

- a. modeling
- b. coaching
- c. scaffolding
- d. articulation
- e. reflection
- f. exploration

APPENDIX B
CONSENT FORM

I, _____, agree to participate in a research project on the talk-aloud method of learning the physical assessment of patients. I do so under my own free will and without any coercion. I maintain the right to withdraw my involvement from this project at any point.

I have been informed of the purpose and nature of this research, and know that any further questions will be answered by the researcher, Rebecca Dyck, or her thesis adviser, Maureen Lucas.

I have been apprised of the risks and benefits involved in my participation in this research. No physical harm will come to me, nor will my academic standing be affected in any way.

I have been guaranteed that my name will not appear in any published document resulting from this research, and that personal information will be treated confidentially. However, I am aware that my name is on Dawson College class lists and that my presence as a member of the affected clinical group could thus be deduced.

I hereby give permission for my interview to be taped and transcribed. All material obtained from me that pertains to the research project, from oral interviews and written reflections and journals, may be used in the production of the research report.

SIGNED: _____ DATE: _____

APPENDIX D

INTERVIEW GUIDE

During this semester we used the think-aloud method of learning patient assessment; I'd like to know what you thought of it, so I have a number of questions to ask you. You've already finished this clinical rotation, so you can speak freely!

- 1) How did you feel about doing the patient assessment in the think-aloud manner?
 - Did your feelings change during the term?

- 2) Of the various times you did the think-aloud assessment process, could you describe to me:
 - your best experience with it,
 - and your worst?

- 3) In reflecting on how the assessment process went, what aspects did you find:
 - helpful, that facilitated your learning?
 - unhelpful, that hindered your learning?

- 4) Could you tell me in what ways you feel that your patient assessment skills have changed during this semester?

- 5) Often there was another student at the bedside when you assessed. What was your perception in terms of how the presence and involvement of other students affected your procedure?
 - How about when you were the one joining another student's assessment process -- was that interesting for you?

- 6) Do you see yourself as having contributed to the learning process of your fellow students?
 - How does this make you feel?

- 7) Usually I was there too, but not always. Speaking frankly, how do you feel my presence and involvement affected your procedure?
- Did you notice changes during the semester in my closeness to/guiding of your assessment process?
 - Did you feel that my proximity or distance matched your own needs at the time?
 - What did you find yourself wishing I would do differently to be more helpful to you?
- 8) Each situation was different, but with your own patients did you feel there was enough preparation time before and debriefing time after you did your assessments?
- Would you have liked more discussion time about it on the ward?
- 9) As you know, I'm interested in the link between assessment and intervention. Could you give me an example of a situation in which one of your assessment findings directly influenced or led to one of your nursing actions?
- 10) Do you feel more confident in applying the nursing process now than before this semester?
- 11) In conclusion, do you feel the think-aloud method should continue to be used for teaching infant assessment?

APPENDIX E
WRITTEN REFLECTION SHEET

Thank you for being willing to share your opinions on the subject of think-aloud assessment of infants and young children. Please jot down any comments you may have.

For example, in reflecting on this method of learning patient assessment, how do you feel about it now? Was it helpful to you?

Did you feel that doing think-aloud assessments helped you to link patient data to nursing actions? Or was there little connection between the two?

Would you say that you feel more competent now in assessing patients and planning consequent care?

How did you feel about the presence and involvement of other students and of the teacher during your patient assessments?

Or any other remarks ... Thanks for taking the time to respond.

APPENDIX F
PATIENT ASSESSMENT QUESTIONNAIRE
at beginning of semester

Please circle the letter(s) that apply to you.

1. Have you done any physical assessments of patients?
 - a. head-to-toe, i.e. complete
 - b. partial, i.e. specific aspects only
 - c. none

2. How did you assess the patient?
 - a. alone, on own initiative
 - b. alone, when directed to do so
 - c. together with an RN
 - d. together with a student
 - e. guided by a teacher
 - f. observed by a teacher

3. How were you taught assessment skills?
 - a. classroom lecture
 - b. videos & tapes
 - c. lab demonstration (circle: on a mannequin, on another student, on yourself, other)
 - d. demonstration on a patient
 - e. textbook readings & handouts
 - f. other:

4. Please describe the experience that has helped you the most so far in learning patient assessment:

5. Do you feel comfortable in performing a patient assessment?
 - a. not at all
 - b. sometimes
 - c. usually
 - d. very

6. Do you feel competent in performing a patient assessment?
 - a. not at all
 - b. sometimes
 - c. usually
 - d. very

7. What would you describe as the main function of the data you gather in assessing a patient?

APPENDIX G
PATIENT ASSESSMENT QUESTIONNAIRE
at end of semester

Having done numerous head-to-toe assessments of patients this term using the think-aloud method, please answer the following questions, and feel free to jot down any other comments you might wish to add.

1. Do you feel comfortable in performing a patient assessment?
 - a. not at all
 - b. sometimes
 - c. usually
 - d. very

2. Do you feel competent in performing a patient assessment?
 - a. not at all
 - b. sometimes
 - c. usually
 - d. very

3. Observing your teacher model a patient assessment was:
 - a. boring
 - b. an overload of information
 - c. helpful
 - d. crucial

4. Observing your peers perform patient assessments was helpful.
 - a. not at all
 - b. sometimes
 - c. usually
 - d. very

5. Doing assessments in the presence of your peers was:
 - a. intimidating
 - b. distracting
 - b. irrelevant
 - c. helpful

6. Do you think you'll be able to transfer your think-aloud assessment skills to "regular" (silent) assessment procedures?
 - a. no
 - b. maybe
 - c. of course
 - d. have already

7. Did you feel that there was enough discussion time before and after you did your patient assessments?
- a. never
 - b. sometimes
 - c. usually
 - d. always

8. What would you describe as the main function of the data you gather in assessing a patient?

9. Please describe the experience that has helped you the most so far in learning patient assessment:

10. Do you feel this think-aloud method should continue to be used for teaching patient assessment?

11. Any additional comments about your opinion of this method?

APPENDIX H

SUMMARY OF RESPONSES TO ENTRY QUESTIONNAIRE

1. Have you done any physical assessments of patients?
 - (3) a. head-to-toe, i.e. complete
 - (3) b. partial, i.e. specific aspects only
 - (0) c. none

All had done assessments, but 50% had only done partial ones.

2. How did you assess the patient?
 - (3) a. alone, on own initiative
 - (2) b. alone, when directed to do so
 - (0) c. together with an RN
 - (2) d. together with a student
 - (3) e. guided by a teacher
 - (4) f. observed by a teacher

67% had been observed by a teacher, but only 50% reported having been "guided" by a teacher. 50% had assessed on their own initiative, 33% had done it with other students, and none had done it with an RN.

3. How were you taught assessment skills?
 - (5) a. classroom lecture
 - (5) b. videos & tapes
 - (4) c. lab demonstration (on a mannequin, on another student, on yourself, other)
 - (3) d. demonstration on a patient
 - (6) e. textbook readings & handouts
 - (0) f. other:

All claimed textbooks as sources of information. 83% included lectures, videos and tapes. 67% also had lab demonstrations, and 50% had been shown on a patient.

4. Please describe the experience that has helped you the most so far in learning patient assessment:

"When my teacher was performing a physical head-to-toe assessment on a patient and she was explaining every step she was doing."

"I had a patient who had an IV. I checked it in the morning and everything was fine. After lunch, I noticed the line was filling with blood. I was able to say that this just started happening when the RN asked."

"Demonstration on another student or myself."

"The teacher sent me into a room, told me to assess him, and then report back to her. I was nervous. When I reported, I realized I hadn't checked the patient's back and had missed a large dressing. I now rarely forget to flip a patient."

"The guidance of my clinical teacher. She was very strict about assessment data and checked all data that we collect."

"I would say experience is the most important thing in learning. If classroom lecture and lab demonstration are well enough we can demonstrate our experience on a patient comfortably."

5. Do you feel comfortable in performing a patient assessment?
- (0) a. not at all
 - (3) b. sometimes
 - (3) c. usually
 - (0) d. very

50% reported feeling comfortable sometimes, 50% usually.

6. Do you feel competent in performing a patient assessment?
- (1) a. not at all
 - (2) b. sometimes
 - (3) c. usually
 - (0) d. very

Less certainty regarding competence: 50% usually felt competent but 33% only sometimes and 17% not at all.

7. What would you describe as the main function of the data you gather in assessing a patient?

"Through the assessment we can find out the normalities and the abnormalities in a patient."

"To complete a picture of present health state of the patient, to see any change in patient health state which happened with the patient since last assessment."

"To catch a problem before it happens (i.e. bedsores), and to check progress of patient whether positive or negative."

"I measured data against a standard or against a previous data. It helps to focus attention on functions which need an assistance."

"You take an assessment first thing per shift. That way if there are changes in your patient, you have information to compare the changes to."

"To realize what patient has so that we may be able to care for them better."

APPENDIX I
SUMMARY OF RESPONSES TO EXIT QUESTIONNAIRE

1. Do you feel comfortable in performing a patient assessment?
(0) a. not at all
(1) b. sometimes
(4) c. usually
(1) d. very

Two-thirds of the group usually felt comfortable performing assessments, 17% did sometimes, 17% felt very comfortable.

2. Do you feel competent in performing a patient assessment?
(0) a. not at all
(2) b. sometimes
(3) c. usually
(1) d. very

50% usually felt competent performing assessments, 33% did sometimes, 17% felt very competent.

3. Observing your teacher model a patient assessment was:
(0) a. boring
(0) b. an overload of information
(4) c. helpful
(2) d. crucial

67% considered it helpful to observe the teacher, and 33% viewed it as crucial.

4. Observing your peers perform patient assessments was helpful.
(0) a. not at all
(1) b. sometimes
(5) c. usually
(0) d. very

83% felt that it was usually helpful to observe their peers, 17% said it sometimes was.

5. Doing assessments in the presence of your peers was:
- (0) a. intimidating
 - (1) b. distracting
 - (0) b. irrelevant
 - (5) c. helpful

83% felt that doing assessments in front of other students was helpful, 17% found it distracting.

6. Do you think you'll be able to transfer your think-aloud assessment skills to "regular" (silent) assessment procedures?
- (0) a. no
 - (1) b. maybe
 - (1) c. of course
 - (4) d. have already

67% report that they have already transferred the think-aloud skills to silent assessments, 17% said that of course they would, and 17% said maybe they would be able to do this.

7. Did you feel that there was enough discussion time before and after you did your patient assessments?
- (0) a. never
 - (2) b. sometimes
 - (2) c. usually
 - (2) d. always

One third said there was sometimes enough discussion time, one third said there usually was, one third said there always was enough.

8. What would you describe as the main function of the data you gather in assessing a patient?

"Gathering data helps to perform nursing actions. If we don't know or have any data about patient's physical and mental states we cannot perform any nursing actions."

"Focussing on most significant data and analyzing it, nurse is able to come up with right patient's diagnosis and therefore to do nursing implementation → to promote patient's well-being."

"It is a systematic way of seeing the improvement or worsening of your patient. It is an almost foolproof way of not forgetting to check every aspect of the patient."

"We assess patients in order to get a complete physical picture of them. By checking all details, we can make a nursing diagnosis and determine goals and orders."

"Information on patient helped to know what nursing actions would have to be done."

"Useful to analyze what is the normal and what is abnormal. Able to focus on assessment with more professional attitude."

9. Please describe the experience that has helped you the most so far in learning patient assessment:

"Observing a teacher doing assessment of patient and doing assessment aloud myself."

"Have peers around to join in while I did assessment on patient because it made me feel less scared that I would forget something, then next time you remember what you forgot."

"When working with newborns and children, it is very difficult to catch every single detail. By doing an assessment in an organized fashion (from head-to-toe) and speaking as you do it, it is harder to forget things."

"In postpartum was where I found the assessment was most useful. We had the chance to look at pre, term, post infants and so thus examined the differences and it brought much of the theory we had learned in class together."

"Doing patient assessment in the presence of peers helped me a lot, because I felt more calm with support and help of other students. Also group discussion after each clinical and teacher's assistance while I was doing patient's assessment helped me feel more comfortable and confident with performing it."

"Head to toe assessment was very helpful in learning normal and abnormal findings in a patient. And it also lead to be a smart professional nurse who can provide the best service to a client."

10. Do you feel this think-aloud method should continue to be used for teaching patient assessment?

"Yes. It was very helpful as long as the person is comfortable with the environment and the surrounding people."

"Yes, it is very helpful."

"Most definitely. Although the first time is slightly nerve-wracking, by the second and third times things flow much more easily."

"It is extremely helpful because if you forget something, you are reminded. It is a great way to learn how to do proper assessments."

"Yes."

"Yes, it is very helpful."

11. Any additional comments about your opinion of this method?

"This method makes students feel more comfortable when assessing a patient, especially with peers. Smart how teacher at end no longer joined when we (students) did assessment."

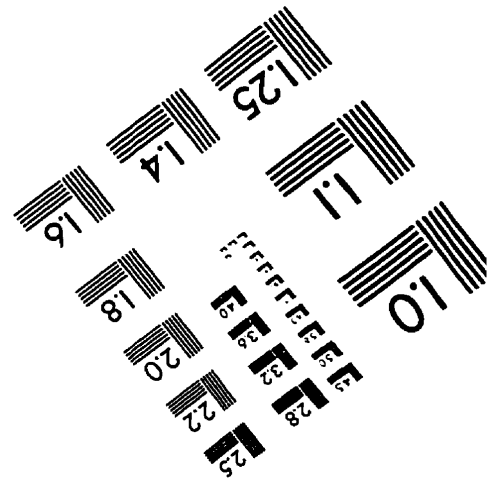
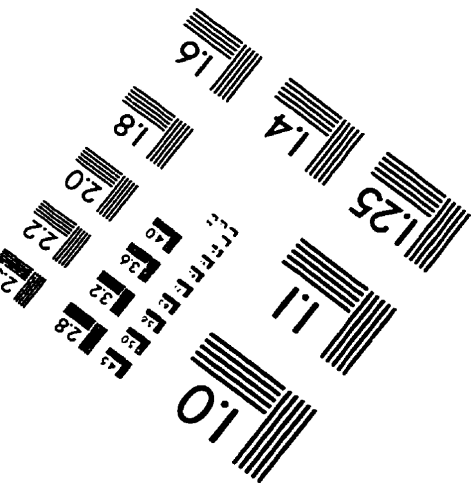
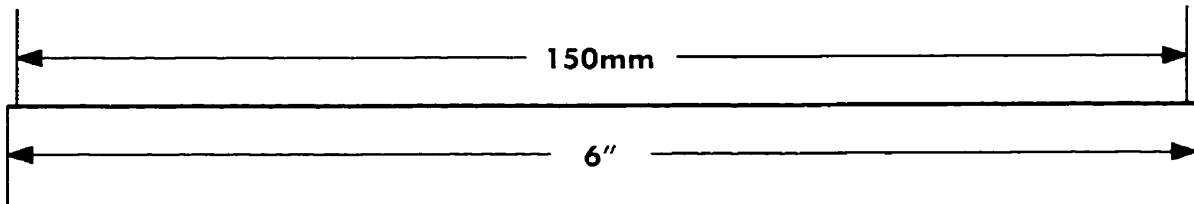
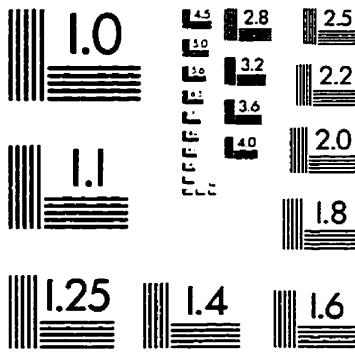
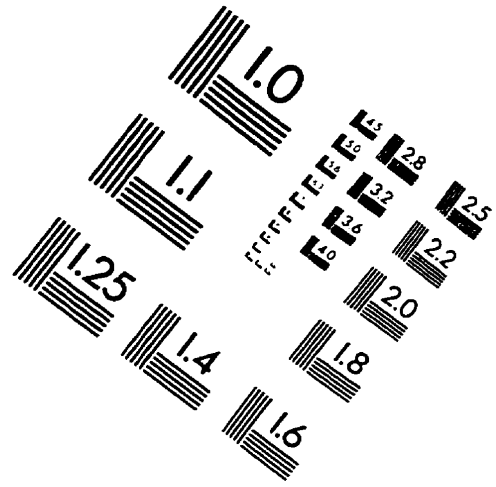
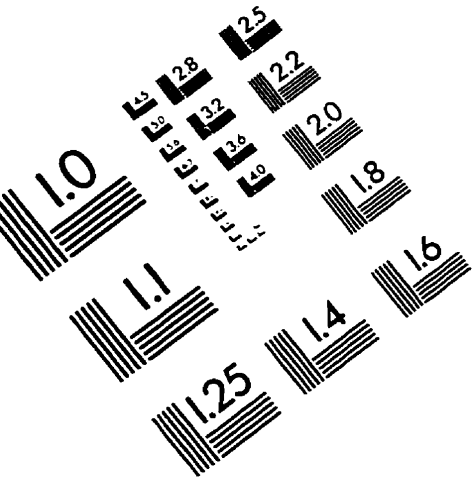
"The think-aloud method is especially useful to students who are just learning how to do assessments. Of course there is always the problem if the patient can understand you. It makes things very difficult to be discreet when doing this method."

"Maybe seeing more abnormalities would have been nice to assess if they were available since I personally only examined "normal" healthy infants."

"I would like to continue my training in performing patient assessment, I want to do it for as many as possible different diagnoses and patients."

"I really liked this kind of assessment. It helped me a lot in my learning experience."

IMAGE EVALUATION TEST TARGET (QA-3)



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