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The University of Nebraska - Lincoln, 1992

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DEVELOPMENT OF A COGNITIVE SELF-REPORT USING THE ACT* THEORY OF COGNITIVE SKILL ACQUISITION

by

Rosemarie Hartley

A DISSERTATION

Presented to the Faculty of
The Graduate College in the University of Nebraska
In Partial Fulfillment of Requirements
For the Degree of Doctor of Philosophy

Major: Interdepartmental Area of Psychological and Cultural Studies

Under the Supervision of Professor David Moshman

Lincoln, Nebraska

March, 1992

DISSERTATION TITLE

Development of a Cognitive Self-Report Using the ACT*

Theory of Cognitive Skill Acquisition

BY

Rosemarie C. Hartley

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CHAPTER I

INTRODUCTION

The practice of nursing requires ongoing assessment of clients' changing conditions, interpretation of data, determination of appropriate nursing actions and evaluation of outcomes. In short, nursing requires expertise in identifying and solving problems. Even newly graduated nurses can expect to be involved in solving complex clinical problems. It follows that nurse educators must prepare graduates who have well practiced problem solving skills.

Many nursing instructors assume that students interpret, organize and apply facts in the same manner in which they are presented in lectures and texts. Those instructors do not consider how students rely upon prior knowledge and experiences to organize and interpret newly acquired information.

Conventional testing methods such as multiple choice or short answer tests, offer little enlightenment to instructors relative to how students think through their responses to clinical problems. Conventional methods very often fail to identify the frameworks used by students to

understand and organize their tasks, or reveal the cognitive steps that produce various solutions.

Given that students organize and process information in unique ways, educators must have a means to identify those cognitive differences so that meaningful teaching methods can be matched to students' performance levels. To date, no efficient method exists in nursing education to assess components of ongoing student problem solving behavior.

The Research Problem

A number of studies involving clinical problem solving in nursing have been conducted. Work by Benner (1983, 1984), Benner and Tanner (1987) and Tanner (1988) exemplifies a major thrust in nursing of the phenomenological perspective of novice to expert cognitive skill acquisition proposed by Dreyfus and Dreyfus (1986). The processes underlying expertise, according to the Dreyfus viewpoint, are beyond adequate explanation by mechanistic or rationalist methods and therefore, cannot be reduced to computer models as is often done in information processing studies. Because the Dreyfus Theory cannot explain behavior of experts it appears to offer little toward design of objective, diagnostic or instructional methods capable of

moving novice nurses toward better methods in making clinical judgements.

An alternative may be found in a theory developed by J. R. Anderson (1982; 1983; 1986; 1987) called the Adaptive Control of Thought, or ACT* (pronounced Act-Star) Theory of Cognitive Skill Acquisition. The Theory specifies stage-like mechanisms by which novices become experts. Verbal protocols collected from novice and expert nurses in an earlier study were consistent with the three cognitive processing stages described in the ACT* Theory (Hartley & Ronning, 1987).

ACT* Theory Stage Level Behavior

Stage one of skill learning in ACT* is the declarative (novice) stage. Learners in this stage have little or no organized knowledge specific to a problem. They use a piecemeal approach and general purpose problem solving strategies to interpret perceived data. Novices, for example, student nurses first encountering a patient with insulin shock, are often unable to retain the information obtained about the problem situation while they search long term memory (LTM) for possible meaning and associations. When connections are found, they often lead to dead ends. Because novices lack specific content knowledge, they rely

on common knowledge to form inferences or analogies that associate isolated facts and/or interpretations into some kind of meaningfully solution. In the case of the patient with insulin shock, the novice, missing or ignoring refuting evidence, might infer that the patient is intoxicated because his behavior fits a stored memory of intoxication.

In stage two, the compilation (intermediate) stage, solvers acquire small stores of specific content knowledge (like facts about diabetes) and learn, through classroom and textbook examples, to use simple, nondiscriminant rules to solve basic problems related to that content. When a solver must interpret the meaning of events in an actual situation, memory is at first heavily relied upon to find and retrieve rules that specify the interpretion of each bit of information. Repeated successes in solving similar types of problems however, result in the elimination of step-by-step memory search. Instead, several steps, noted by the solver to have worked in solving the class of problems, begin to occur as a smooth coordinated set. For example, the intermediate level nursing student will be able to use clinical assessment rules to interpret most of a patient's observed signs and symptoms and group them into meaningful clusters (e.g., vital signs), obtain and use patient history

and assessment findings to select a likely diagnostic category (diabetes) and retrieve/match basic stored information (signs of coma verus shock) to the actual situation. Discriminating contextual information embedded in complex problems will be overlooked by this level solver due to lack of experience needed to form additions and exceptions to general clinical rules.

Experts, those who have reached the procedural stage (stage three), rapidly identify the critical elements of a problem. What they perceive triggers automatic application of an organized set of cognitive responses that are specified in memory as the conditional actions to take when specific situational/contextual conditions are present. Because experts initially characterize problems outside conscious awareness, processing capacity is free to interpret subtle contextual information that differentiates complex problems. Increasing levels of expertise are achieved in this manner (Anderson, 1982; 1983; 1987). To continue the above example, an expert nurse knowing a patient is diabetic, will immediately isolate the critical signs that differentiate coma from shock, and then validate the match by explaining causation based upon the context in

which the patient is found, for example, the third trimester of pregnancy.

Although ACT* provides a useful framework to identify information processing differences in learners, it is impractical to collect protocol data, traditionally used for information processing analyses, in classrooms. Additionally, analysis procedures are time consuming, dependent upon error-free transcriptions and reliability of trained coders.

Prompted by similar constraints, Rest and others constructed a paper-pencil instrument with fixed-choice, stage-related items, to document subjects' interpretations of Kolberg's moral dilemmas (Rest, 1975; Rest, Cooper, Coder et al., 1974). The instrument was able to reflect stage shifts in subjects' response patterns that were consistent with their written justifications scored according to Kolberg's scoring rules. There is, then, a precedent for proposing that a paper-pencil instrument can be used to identify stage-like patterns in clinical problem solvers.

Purposes of the Study

The purpose of the proposed study was to assess reliability and validity of a nine item, fixed-choice/open-ended instrument: The Cognitive Process Self

Report (CPSR). This instrument was constructed by the investigator to assess cognitive skill stage level in nurses. A secondary purpose of the study was to contribute to the construct validity of the ACT* Theory used here as the theoretical basis of the CPSR development. Related purposes were to determine if identified differences in problem solving of student/nurse subjects were related to differences in subjects' initial interpretations of a problem and to subjects' reported levels of clinical knowledge and experience.

Significance of the Study

Investigators in other fields such as chess, physics, social studies and medicine have documented the presence of qualitatively different problem solving patterns among solvers with different levels of experience (deGroot, 1966; Larkin, 1983; Larkin, McDermott, Simon & Simon, 1980; Lesgold, 1984; Lesgold, Feltovich, Glaser & Wang, 1981; Voss, Tyler & Yengo, 1983). Studies in the area of nursing have more recently begun to address the issue. Verbal protocols have been analyzed by nurse investigators to obtain categorical group data about clinical problem solving (Kerr, 1987; Tanner, Padric, Westfall & Putzier, 1987).

Little attention, however, has been given to applying theory from cognitive psychology to research findings.

Presently, outcome measures in nursing education are being stressed by accrediting bodies. Given this trend, availability of a reliable paper-pencil method to assess information processing at different stages in a student's career is of practical significance. Once identified, changing patterns in the student's abilities to organize and process information can be matched to stage-appropriate teaching methods to help reach desired outcomes.

Research Questions

The specific questions addressed in this study were:

1. Can adequate measures of reliability be established for the Cognitive Process Self-Report (CPSR)?
2. Is there evidence of a positive relationship between the levels used to classify subjects on the CPSR and subjects' levels of clinical experience?
3. Do the nine items on the CPSR individually and collectively identify subgroup differences in reported cognitive actions that are consistent with stage-related, goal-directed cognitive actions described by Anderson (1982, 1983, 1987)?

4. Is there a relationship between subjects' level of problem representation and their cognitive skill level classification on the CPSR?