Problem Solving and Conceptual Research Use in Registered Nurses

by

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Abstract

Purpose: My aim of this research project was to explore and compare the relationship between perceptions of problem solving abilities and self-reports of conceptual research use in registered nurses working in pediatric acute-care and adult long-term care settings.

Design: This is a paper-based thesis comprised of three Chapters: (1) an introduction; (2) an empirical study; and (3) an overview of results with further discussion and conclusions.

Methods: I used survey data previously collected from two longitudinal research programs, *Translating Research in Elder Care* and *Translating Research on Pain in Children* to conduct the secondary analysis. The sample for this study included 766 pediatric nurses and 160 long-term care nurses. Problem solving was measured using a 10-item scale. Conceptual research use as measured in two ways: using a single item question and a 5-item scale. Bivariate and multivariate statistical techniques were used to address my research questions. Variables known to influence research use were included in regression analyses as control variables. This empirical study, presented in Chapter 2, will be submitted to a peer-reviewed journal for publication.

Results: My results were mixed and unexpected. Self-perceived problem solving abilities of long-term care and pediatric nurses were not significantly different. The two groups were significantly different in their conceptual research use scores, but only when analyzed using the single item measure. Problem solving and conceptual research use (single item) were significantly correlated in both long-term care and pediatric nurses. Problem solving was a significant predictor of conceptual research use (single item) but only in the pediatric nurses.

Conclusions: My findings add to the limited knowledge on this topic area by providing some important preliminary insights into the relationship between problem solving and conceptual research use in registered nurses. More research needs to be done to further our knowledge and understanding of this topic area.

Preface

This thesis is an original work by Christina Manraj. The research project, which this thesis describes, received research ethics approval from the University of Alberta Research Ethics Board, Project Name "PROBLEM SOLVING AND RESEARCH UTILIZATION", No. Pro00038743, May 27, 2013. This research project is a secondary analysis with the original data collected as part of two national research studies led by Professor Carole A. Estabrooks at the University of Alberta: "BUILDING CONTEXT - AN ORGANIZATIONAL MONITORING PROGRAM IN LONG-TERM CARE PROJECT 1 ON THE TRANSLATING RESEARCH IN ELDER CARE [TREC] PROGRAM" and "TRANSLATING RESEARCH ON PAIN IN CHILDREN PROJECT 2" with data collection occurring in 2010 and 2011 respectively. I designed this research project with the assistance of Dr. Estabrooks. The data analysis and conclusions are my original work. The research model outlined in Chapter 1, although designed by myself, is an amalgamation and modification of the Promoting Action on Research Implementation in Health Services (PARIHS) framework and Diffusion of Innovations Theory. To date, no part of this thesis has been previously published.

The manuscript in Chapter 2 of this thesis will be submitted for publication as C.L. Manraj, C.A. Estabrooks, and J. Profetto-McGrath to the *International Journal of Nursing Studies*. I conducted the literature review, data analysis, and manuscript composition. Dr. Estabrooks was the supervisory author and provided critical feedback. All authors participated in reviewing the manuscript and manuscript edits.

Dedication

To Granny Manny for teaching me the importance of education;

who was thrilled to see me start my Master in Nursing program

but did not get to see me finish it.

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I would like to thank several people who have supported me throughout the completion of my thesis research project.

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CHAPTER 1: Introduction

Introduction and Overview

This thesis document is the outcome of my master of nursing program in research. The *purpose of my research was to study the relationship between self-perceived problem solving ability and conceptual research use in two discrete sets of registered nurses*. My thesis is 'paper-based' or 'manuscript based' and is composed of three chapters. In chapter 1, I describe and review relevant background literature and provide information about the research methods used in this project. In chapter 2, I present the main component of this thesis, the research manuscript, which will be submitted for publication. In the final chapter, I summarize the findings from this research project and how they contribute to existing research, as well as discuss directions for future research.

Context of the Problem

Nursing care can positively or negatively impact patient health outcomes [1-3]. In the fast-paced modern healthcare environment with its high acuity levels, nurses must be able to resolve patient problems and concerns effectively, efficiently, and safely. Within the Canadian healthcare system, nurses are the largest group of healthcare professionals and provide the majority of care to patients [4, 5]. Consequently, the opportunities for nurses to make potentially erroneous decisions resulting in patient harm are numerous [5, 6]. Unfortunately, patient adverse events, such as unintended injuries and preventable complications, are not rare. In Canada, it is estimated that 7.5% of the 2.5 million patients admitted to hospital annually, experience an adverse event; approximately half of these adverse events are considered to be preventable [7].

Nurses have an important role in mitigating adverse events and ensuring safe quality care is provided to patients.

In order to deliver high quality care to patients, two important processes among others need to occur. First, nurses need to engage in effective problem solving. Problem solving has been identified as a necessary competence in providing safe quality care [8]. Problem solving has been defined as the means by which an individual uses cognitive processes, such as decision making and critical thinking, acquired through previous knowledge, skills, and understanding, to resolve difficult situations [9]. Generally, successful problem solvers are more effective, more systematic, have a clearer understanding of a problem, are less impulsive, and are less likely to avoid problems [10]. These characteristics of successful problem solvers are of clear benefit in nursing practice. Nurses who naturally avoid problems may fail to identify and respond to a patient experiencing one or more life-threatening symptoms. Furthermore, choosing the wrong solution or intervention for a patient's symptom may lead to poor patient outcomes and/or adverse events. This is a key reason why nurses need to be and are expected to be independent thinkers, capable of using problem solving skills and evidence-based decision making to provide the best possible care to patients [11]. Of particular importance is the nurse's ability to make appropriate assessments to recognize patient health problems and develop care plans to address those problems [12]. The implementation of the nursing process, as the standard to plan patient care, has accentuated the need for nurses with effective problem solving skills [13]. Even though the ability to engage in effective problem solving is recognized as one of the salient features of nursing practice [13], I was unable to locate any research articles that examined problem solving in practicing nurses.

A second process necessary for optimal clinical decision making and high quality care in nursing is the use of research to inform clinical decisions and practice [14]. The use of research or *research utilization* is a specific form of knowledge utilization [15]. Broadly defined, research utilization is the implementation of research findings in practice [16, 17]. Increased research utilization has been linked to decreased adverse outcomes in patients [18]. Integrating research into clinical practice is the current standard within the healthcare disciplines [6]. Nurses are expected to engage in evidence-based practice, regardless of their educational preparation [14]. However, studies have reported that the uptake of research findings into healthcare professional practice, including nursing, is delayed and sporadic [19, 20]. Additionally, nurses have been slow to adopt research findings into their clinical practice and tend to rely on information from other people, usually nursing colleagues, or their own past experience to inform their practice [21-23]. As a result, it remains uncertain as to whether or not nurses are consistently using current research in their clinical practice [17, 24, 25]. This phenomenon is generally referred to as the research-practice gap. Thus, nurses may be bound by their previous, and perhaps outdated, knowledge and may be unable to respond effectively as new patient problems, conditions, and situations arise [13].

Attempts to improve nurses' problem solving skills and research use in practice have begun in nursing education programs. There has been a shift from traditional task-based learning to problem-based learning (PBL) curricula in the health sciences, including nursing. In a PBL curriculum students are supported to and are required to use their problem solving and research skills to work through clinical scenarios. Undergraduate nursing programs that use PBL approaches foster skills in problem solving, critical thinking, and evidence-based practice [26]. Furthermore, research suggests that this teaching method is effective in supporting clinical

problem solving through the nursing process [5, 27]. Thus, educators argue that PBL courses that promote use of the problem solving process provide motivation and skills for students to incorporate research into their practice as professional nurses [14].

However, we do not yet have evidence that these problem solving skills taught in the classroom actually equate to more research being used in practice. Further, we do not know if nurses with naturally higher perceptions of their problem solving abilities use more research in practice. Thus, in this thesis research project I sought to explore the relationship between perceptions of problem solving ability and research use in registered nurses in an attempt to fill this knowledge gap.

There are several research studies aimed at investigating the individual determinants of research use; however problem solving perceptions has not yet been an area of focus. As data were available to me with which I could explore problem solving and research use, I decided to pursue this research problem. As noted earlier, this relationship in two groups of registered nurses has not been studied previously.

Purpose

The purpose of my research project was to determine how and if problem solving perceptions and conceptual research use are related in registered nurses.

Research Questions

The research questions guiding this thesis are as follows:

1. What is the relationship between perceptions of problem solving ability and conceptual research use in registered nurses working in acute-care pediatric settings?

2. What is the relationship between perceptions of problem solving ability and conceptual research use in registered nurses working in adult long-term care (LTC) settings?
3. What is the difference between perceptions of problem solving ability and conceptual research use in registered nurses working in adult LTC versus pediatric acute-care?
4. Which aspects (if any) of CRU are predicted by perceptions of problem solving ability in registered nurses who work in pediatric acute-care versus adult LTC?

Design

In this thesis research project I sought to examine the relationship between registered nurses' perceptions of their problem solving ability and self-reported CRU. I designed and conducted a secondary analysis using two unique quantitative datasets available from the Knowledge Utilization Studies Program (KUSP) that were collected in 2010 and 2011. The focus of my secondary analysis was to use multiple regression models with variable selection guided by research utilization literature and two theoretical frameworks: (1) Promoting Action on Research Implementation in Health Services (PARIHS) framework and (2) Diffusion of Innovations theory (see descriptions below). This manuscript can be found in Chapter 2 and will be submitted for publication to the *International Journal of Nursing Studies*.

Theoretical Frameworks

This thesis research project was guided by a combination of two theoretical frameworks: Rogers' Diffusion of Innovations Theory and the PARIHS framework. Together this theory and framework seek to understand the spread and implementation of research in practice. Both this theory and framework have previously been used to study research use in nursing.

1. Diffusion of Innovations Theory

The classic Rogers' Diffusion of Innovations theory seeks to explain and understand the ways in which new ideas, or innovations, are adopted by individuals and/or populations [28]. The Diffusion of Innovations theory has been used in several disciplines including agriculture, marketing, and healthcare [28]. The core text in this field is Rogers' *Diffusion of Innovations* [29].

Rogers [29] defines diffusion as the "process by which an innovation is communicated through certain channels over time among the members of a social system" (p. 5). There are four main concepts that contribute to diffusion*: innovation*, *communication*, *social system*, and *time* [29]. Like other scholars have done in the field of nursing, I made the assumption that in this study, research use was to be treated as analogous to innovation diffusion [19, 30].

Innovation

Rogers [29] conceptualizes an *innovation* as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (p. 12). Whereby the idea only needs to appear new to the individual, it does not necessarily need to be new [29]. The rate of adoption of an innovation is affected by the perceived characteristics of the innovations, namely: relative advantage, compatibility, complexity, trialability, and observability [29]. Therefore, innovations that are perceived to have all five of these characteristics will be adopted more rapidly than other innovations [29].

Communication

C*ommunication* is a process in which information is created and shared between two or more individuals for the purpose of achieving a mutual understanding [29]. Rogers [29] describes *communication channels* as the method for exchanging information between

individuals; these channels can be either mass media channels (radio, television, newspapers, etc.) or interpersonal channels (a face-to-face exchange). Furthermore, Rogers [29] suggests that individuals depend mainly on a subjective evaluation of an innovation from an individual who has already adopted the innovation, rather than evaluating the innovation for themselves.

Social system

A *social system* consists of a number of interrelated units, made up of groups of individuals, which are "engaged in joint problem solving to accomplish a common goal" [[29]; p. 23]. Diffusion then occurs within a social system and the social system sets the boundaries within which the innovation can diffuse [29]. Furthermore, the structure of the social system, system norms, opinion leaders and change agents, types of innovation-decisions and the consequences of innovation all affect the innovation's diffusion [29].

Time

Time as part of the diffusion process consists of three elements*: innovativeness of individuals,* the *rate of adoption of the innovation,* the *innovation-diffusion process* [29]. *Individual innovativeness* is described as a continuum of adopter categories (a) innovators, b) early adopters, c) early majority, d) late majority, and e) laggards) that indicate the degree to which an individual adopts an innovation [29]. These adopter categories range from, venturesome individuals who actively seek information about new ideas (innovators) to individuals suspicious of innovations and change agents and are last to adopt an innovation (laggards) [29]. Individual innovativeness influences *the rate of adoption* [29]. The *innovation-diffusion process* is composed of five steps that an individual passes through when deciding to adopt or reject a new idea or innovation; these steps comprise the core of the innovation of diffusion theory [29]. Rogers [29] conceptualizes these steps as follows:

1. Knowledge: when an individual learns that the innovation exists;
2. Persuasion: when an individual forms an attitude, either favorable or unfavorable, towards the innovation;
3. Decision: when an individual makes a choice to either adopt or reject the innovation though engagement in activities (e.g., problem solving);
4. Implementation: when an individual begins to use the innovation (e.g., research use); and
5. Confirmation: when an individual assesses the implementation of the innovation and reassesses the innovation-decision that has already been made.

This innovation-decision process is gradual and involves information seeking and processing and individuals may not necessarily pass through the stages in the order presented above [29].

Summary

The relationship between these elements represents the complex process of research use. Figure 1 depicts the elements of Diffusion of Innovations theory.

2. Promoting Action on Research Implementation in Health Services (PARIHS) Framework

The PARIHS framework can be used to diagnose critical elements related to the implementation of research into practice and then afterwards be used to develop a successful implementation strategy [31]. In this framework, three elements (evidence, context, and facilitation) are considered necessary for the successful implementation of research into practice [32-36]. Successful implementation is a function of evidence, context, and facilitation and the interrelationships between these three elements [37]. Each of these elements can be assessed as to whether it will have a weak (low rating) or strong (high rating) effect on successful

implementation [33]. As a result of these three elements, the effect of an implementation intervention may be entirely different in different settings [37].

Evidence

Within the PARIHS framework, *evidence* is broadly defined to include a number of sources of knowledge including: research evidence, clinical experience, local data or information and patient experience [34, 36]. While research evidence may be treated as the most heavily weighted source of evidence, a fundamental premise of PARIHS is that all four sources of evidence have meaning and constitute evidence from end user perspectives [37]. Additionally, for the successful implementation of evidence to inform decision-making, critical appraisal of the evidence, regardless of type, is needed prior to implementation [34, 36]. Examples of high ratings of evidence include: evidence that is valued as evidence, judged as relevant, has conclusions drawn from it, and has its importance weighted [37].

Context

The second element, *context* is recognized as "the environment or setting in which people receive healthcare services, or in the context of getting research evidence into practice, the environment or setting in which the proposed change is to be implemented" [[36]; p. 299]. Within this element of context are four broad themes: *culture*, defined as a way of viewing or thinking about a context and includes values, beliefs, and assumptions; *leadership* which represents the overall power structure in decision making; *evaluation* which is related to multiple levels and sources of feedback; and *receptivity* which represents the readiness or fit of critical elements of the environment as they relate to evidence uptake and includes: resources, space, and fit of the innovation within the organization [31, 32]. Examples of high ratings of context include: transformational leadership practices, democratic decision making, feedback on

individual, team, and/or system performance, valuing individual staff, and clearly defined boundaries [35, 38].

Facilitation

The third element, *facilitation*, is defined as "providing help and support to achieve a specific goal to enable individuals and teams to analyze, reflect, and change their own attitudes, behaviors and ways of working" [[39]; p. 580]. Stetler *et al*. [40] add that facilitation is "a deliberate and valued process of interactive problem solving and support that occurs in the context of a recognized need for improvement and a supportive interpersonal relationship" (p. 6). There are three components of facilitation: the *purpose*, *role*, and *skills and attributes* that contribute to successful implementation [32-36]. *Purpose* is considered as a continuum ranging from task-oriented (specific goal attainment) to holistic-oriented (enabling individuals and teams to change their ways of working and attitudes through reflection) [35]. Within these two purposes, *role* and *skills and attributes* are described. For example, a facilitator's role would be to *do for others* using technical, marketing, or project management skills within the task-oriented side of the continuum and to *enable others* on the holistic-oriented side using critical reflection and co-counseling skills [37]. More recently, facilitation has been viewed as both an individual role and a process that involves both individuals and groups [41]. Facilitation is growing as a method for encouraging research use in clinical practice, particularly in nursing [42]. However, there is an increasing need to evaluate the outcomes of facilitation with respect to actions taken [41].

Summary

The dynamic relationship between these three elements represents the complex process of implementing research into practice (research use). This framework has been used as an

organizing framework in several empirical studies within nursing, which have examined the determinants or predictors of research use [18, 30, 43]. Figure 2 represents the PARIHS framework.

Theoretical Framework for this Study

I chose to incorporate elements of both the PARIHS framework and the Diffusion of Innovations theory to guide this thesis research project. However, while my study did use concepts from these two theoretical frameworks to guide the empirical analysis, it did not represent an empirical test of them. Instead, I used this theory and framework in addition to research literature to substantiate my choice of independent and dependent variables. Furthermore, I have used this framework and theory to justify my decision to address both the individual and contextual elements of my research questions.

Both of the Diffusion of Innovations theory and the PARIHS framework highlight that different *contexts* and *social systems* affect the successful diffusion and implementation of research. In my study, in order to understand this relationship, I chose to compare the differences in problem solving ability and CRU in two different nursing work settings (i.e., pediatric acute-care vs. adult LTC). Additionally, I examined the predictive nature of problem solving on research use when controlling for known context variables. The Diffusion of Innovations theory suggests that individual characteristics affect research use [29]. I sought to understand this connection by specifically exploring individual determinants (e.g., problem solving ability, attitude towards research, belief suspension, etc.) as predictors of CRU. Within the Diffusion of Innovations theory, my study is situated within the *Innovation-Diffusion process*, whereby the theoretical link between both problem solving, as an element of *decision*, and research use, as an

element of *implementation*, has been proposed. Figure 3 depicts how I have chosen to incorporate these two frameworks into my study.

Methods

Design and Datasets

I conducted a secondary analysis of quantitative data that had been previously collected as part of two discrete national (Canadian) programs of research. The first dataset *Translating Research in Elder Care (TREC)*, Project 1 Wave 2 was collected in 2010. The second dataset *Translating Research on Pain in Children (TROPIC)*, Project 2 Time 2 was collected in 2011. Data from these two research programs were used with the permission of the principle investigator Dr. Carole A. Estabrooks. Surveys were used to collect data from healthcare providers in both the *TREC* and *TROPIC* research projects. In my study, only survey data from healthcare providers identified as registered nurses were used in the secondary analysis.

Settings

In both the *TREC* and *TROPIC* research projects, data were collected from multiple sites and healthcare providers. In *TREC*, data were collected from healthcare providers in 36 residential LTC facilities across the Canadian Prairie Provinces (Alberta, Saskatchewan and Manitoba). The 36 *TREC* sites had 30 urban and 6 rural care facilities for a total of 103 resident care units (89 urban resident care units) [44]. The typical LTC facility had 3.5 units and the facilities ranged in size from 52 to 446 beds. In LTC the majority (70-80%) of healthcare providers are healthcare aides; thus, the majority of data collected was from healthcare aides. Data for *TROPIC* were collected from healthcare providers in 8 acute-care Canadian pediatric healthcare institutions. The 8 pediatric hospitals had 32 patient care units (4 per hospital); these

units were a combination of medical, surgical, and critical care [44]. In these acute-care pediatric units, the majority of the healthcare providers were registered nurses.

Samples

All healthcare personnel, including nurses, allied health providers, managers, physicians, practice specialists and unregulated healthcare aides (*TREC* only), working in the selected participating facilities were eligible for participation in these studies. All regulated healthcare personnel completed web-based surveys; participants were given a special code, which enabled them to access and complete the online survey. In *TREC*, healthcare aides were surveyed using computer-assisted personal interviews. All *TREC* surveys were conducted in English. Of the 559 regulated staff surveyed in *TREC* (wave 2), 160 were identified as registered nurses; these 160 nurses constituted the LTC sample for this research project. In *TROPIC* (time 2), 779 of the 1079 regulated staff surveyed were registered nurses. In *TROPIC*, participants were given the option of taking the survey in English or French. Of the 779 nurses, 766 were included in this study; 13 nurses were excluded because of incomplete responses to the variables of interest.

Measures

The surveys were developed and tested by the original research investigators and were nearly identical having been adapted for either a pediatric or LTC setting. Information related to work environment, research use, decision-making, information sharing, organizational resources and processes, health and well-being, and demographic information were captured by the survey questions.

Dependent Variable

- *Conceptual Research Use (CRU)*:

- *Definition:* the use of research to change one's thinking or understanding, but may not necessarily change one's action [17].
- *Operationalization:*
    - CRU (single item): Participants were provided with the definition and asked, "On your last typical work day, how often did you use research in this way?" This single item was scored on a 5-point Likert-type scale. Coding for the responses was as follows: 10% or less of the time = 1; 25% = 2; 50% = 3; 75% = 4; and almost 100% of the time = 5. Estabrooks [45] reports that these measures have shown both reliability and construct validity.
    - CRU (scale): a 5-item scale scored on a 5-point Likert-type scale. Participants were asked: "How often did research findings do any of the following?" Concepts included in these items were: give new knowledge, raise your awareness, change your mind, give you new ideas, and help you make sense of things – all relating to care of the resident/ patient. Coding for the responses was as follows: 10% or less of the time = 1; 25% = 2; 50% = 3; 75% = 4; and almost 100% of the time = 5. The overall score for the CRU scale was derived by taking the mean of the 5-items. Possible range for the final CRU score is 1-5. Missing values were coded as 9. This scale has previously demonstrated good reliability (Cronbach alpha = 0.894) and validity [46, 47].

Independent variables

- *Problem Solving* (Variable of Interest):
    - *Definition:* one's self-efficacy and decision making in critical thinking situations in which a problem is presented; one's beliefs and opinions about their ability to solve problems; one's style of problem solving; one's process of problem solving [48, 49].
    - *Operationalization:* this abbreviated (10-item) Likert-type scale (1 = strongly disagree to 5 = strongly agree) was derived from Heppner's *Problem Solving Inventory* [48, 49]. The 10-items with the highest factor loadings, out of the original 35-items, were chosen to derive this abbreviated scale [50]. The three negatively worded items (items 3, 4, 10) are reverse coded; therefore strongly disagree is recoded to strongly agree, disagree is recoded to agree, and so on. The mean of the 10-items, using the recoded scores, was used to create a derived score for this variable. The overall possible range of scores is from 1-5; higher total scores indicate more positive perceptions of problem solving abilities. Missing data were coded as a 9. This abbreviated scale has shown good reliability (Cronbach alpha = 0.74).

Control (Explanatory) Variables

- *Attitude:*
    - *Definition:* one's expressed opinion toward research [51].
    - *Operationalization:* an abbreviated (6-item) Likert-type scale (1 = strongly disagree to 5 = strongly agree) based on the Lacey's [51] adaptation of an earlier

questionnaire developed by Champion and Leach [52] was used to collect data on attitude towards research. Three of the 6-items (items 2, 4, and 6) are reverse coded (i.e. strongly disagree is recoded to strongly agree, disagree is recoded to agree, etc.). Missing data were coded with a 9.The overall score for attitude towards research is derived by taking the mean of the 6-items (using the recoded items). Therefore, the possible range for the final score is 1-5. Estabrooks *et al*. [45] report that this abbreviated scale has good reliability (Cronbach alpha = 0.74) as well as construct validity (48% of the variance determined by one factor).

- *Belief Suspension (implement and willingness):*
    - *Definition*: the degree to which research is congruent with one's personal beliefs; the willingness to and frequency of using research when it contradicts information acquired prior to, during, or after formal education [50].
    - *Operationalization*: composed of two elements or subscales: a) willingness to suspend the belief and b) implementation, actual suspension of the belief. A 6-item (3-items for each element) Likert-type (1 = strongly disagree to 5 = strongly agree) scale developed by Estabrooks [50] was used to collect data on this variable. The belief suspension scale has good reliability (Cronbach alpha = 0.87) and construct validity (78% of variance determined by two factors) [45]. In this study belief suspension was split into two variables (*willingness* and *implementation*), with the score for each determined by the mean of the three survey items, as per the *TREC* and *TROPIC* study codebooks. Higher total scores

indicate a higher degree of belief suspension; final variable scores can range from 1-5. Missing data is indicated with a 9.

- *Burnout:*
    - *Definition:* a syndrome of emotional exhaustion and cynicism [53].
    - *Operationalization:* a shortened version (9-item) of the Maslach Burnout Inventory General Survey (MBI) [53] was used to measure this variable. These 9-items comprise three elements or subscales (3-items per subscale): *exhaustion, cynicism,* and *efficacy*. Each of these subscales constituted a variable in my study. A Likert-type scale was used to capture the frequency of feelings related to burnout; participant responses included never, sporadic, now and then, regularly, often, very often and daily. Coding of the responses ranged from 0 (never) to 6 (daily); missing data was indicated with a 9. The overall score for each of the three elements was derived by taking the mean of their 3-items within the scale. Higher values of exhaustion and cynicism and lower values of efficacy indicate a greater degree of burnout. The original inventory has been reported to have good reliability (Cronbach alpha coefficients ranging from 0.88 to 0.90) [45].

- **Culture:*
    - *Definition:* a way of viewing or thinking about a context and includes values, beliefs and assumptions [32].
    - *Operationalization:* a 6-item scale scored on a 5-point Likert-type scale (1 = strongly disagree to 5 = strongly agree). Concepts reflected in these items include:

recognition, autonomy, work life balance, development opportunity, focus on service/mission, and support. The overall score for culture was derived by taking the average (mean) of the 6-items; therefore, the final score for culture can range from 1-5 with higher values indicating a more positive culture. Missing data was coded with a 9.

- **Evaluation (feedback):*
    - *Definition:* multiple levels and sources of audit and feedback [32]. The process of using data from a group or team to assess performance and achieve outcomes at the unit or organizational level [54].
    - *Operationalization:* a 6-item scale scored on a 5-point Likert-type scale (1 = strongly disagree to 5 = strongly agree). Concepts reflected in these items include: data access, informal data review, formal data review, action planning, performance monitoring, and benchmarking. The overall score for evaluation was derived by taking the mean of the 6-items; therefore, the final score for evaluation can range from 1-5 with higher values indicating more positive evaluation. Missing data was coded with a 9.

- **Interactions (formal and informal):*
    - *Definition:* exchanges that occur between individuals working within an organization or unit to promote the transfer of knowledge; these exchanges can be formal (scheduled activities) or informal (not planned) [54].

- *Operationalization:* formal interactions and informal interactions were treated as two separate variables in this study. *Formal interactions:* 4-items scored on a Likert-type frequency scale (1 = never to 5 = almost always). Concept reflected in items: interactions with others through engagement in formal organizational or unit activities. *Informal interactions:* 10-items scored on a Likert-type frequency scale (1 = never to 5 = almost always). Concept reflected in items: interactions with others through engagement in informal organizational or unit activities. In both variables, responses were recoded as follows: recode 1 (never) and 2 (rarely) to 0 (no interaction); recode 3 (occasionally) to 0.5 (interaction); and recode 4 (frequently) and 5 (almost always) to 1 (interaction). The overall score for each variable was derived by taking a count of these recoded items. Missing data were coded as a 9.

- *Job satisfaction:*
  - *Definition:* the degree to which an individual is fulfilled by the work they do.
  - *Operationalization:* single item using a Likert-type scale (1 = strongly disagree to 5 = strongly agree) was used in the *TREC* and *TROPIC* surveys to assess job satisfaction. The item was as follows: "Overall, I am satisfied with my present job". Scores for this item can range from 1-5; a higher value indicates greater degree of job satisfaction. Missing data were coded with a 9.

- **Leadership:*
    - *Definition:* the overall power structure in decision making [32]. Formal leader's actions within an organization or unit to influence change in practice [54].
    - *Operationalization:* a 6-item scale scored on a 5-point Likert-type scale (1 = strongly disagree to 5 = strongly agree). Concepts reflected in these items include: openness, optimism, self-control, empathy, developing others, and conflict management. The overall score for leadership was derived by taking the mean of the 6-items; therefore, the final score for leadership can range from 1-5 with higher values indicating more positive leadership. Missing data was coded with a 9.

- **Organizational slack (staffing, space, and time):*
    - *Definition:* the cushion of actual or potential resources which allows an organization or unit to adapt successfully adapt to internal or external changes [54].
    - *Operationalization:* staffing, space, and time were treated as three separate variables in this study. *Organizational slack-staffing:* 3-items scored on a Likert-type agreement scale (1 = strongly disagree to 5 = strongly agree). Concept reflected in items: availability of adequate staffing resources. *Organizational slack-space:* 2-items scored on a Likert-type agreement scale (1 = strongly disagree to 5 = strongly agree) and a single item scored on a Likert-type frequency scale (1 = never to 5 = almost always). Concepts reflected in items: availability and use of space. *Organizational slack-time:* 4-items scored on a

Likert-type frequency scale (1 = never to 5 = almost always). Concept reflected in items availability and use of time. Each variable score was derived by taking the mean of its items; possible range of scores for all variables is 1-5. Missing data was coded as 9.

- **Resources (structural and electronic):*
    - *Definition:* the elements (structural or electronic) of an organization or unit that assist with assessing and using knowledge [54].
    - *Operationalization:* structural resources and electronic resources were treated as one variable in this study. Concepts reflected in items: availability/ use of structural resources and availability/ use of electronic resources. *Structural resources:* 7-items scored on a Likert-type frequency scale (1 = never to 5 = almost always with a 6 = not available option). *Electronic resources*: 4-items scored on a Likert-type frequency scale (1 = never to 5 = almost always with a 6 = not available option). If they answered 'never' or 'not available' to 'a computer hooked to the internet,' they were coded as an 8 (not applicable to the three items on electronic resources that follow this item). Missing data were coded as a 9. Responses were recoded as follows: recode 1 (never) and 2 (rarely) to 0 (no resources); recode 3 (occasionally) to 0.5 (resources); recode 4 (frequently) and 5 (almost always) to 1 (resources); and recode 6 (not available) and 8 (not applicable) as 0 (no resources). The overall score was derived by taking a count of the 11 items using the recoded scores.

* Alberta Context Tool variables: In its entirety this tool has been shown to explain 70% of the variance in organizational context and to have good reliability on its constituent sub-scales (Cronbach alpha, range = 0.65 to 0.92) [45, 54].

Demographic Variables

- *Age:*
    - *Definition:* age range in years old.
    - *Operationalization:* single item with 12 categorical response options was used in the *TREC* and *TROPIC* surveys to indicate the age of the participant. The item was as follows: "Please indicate your age group by checking one of the following: <20 years, 20-24 years, 25-29 years, 30-34 years, 35-39 years, 40-44 years, 45-49 years, 50-54 years, 55-50 years, 60-64 years, 65-70 years, or >70 years". This variable was coded sequentially, whereby a score of 1 was given to participants who respond <20 years and 2 was given to a response of 20-24, and so on. Therefore, scores for this variable can range from 1-12. Missing data were coded with 99.

- *Educational level:*
    - *Definition:* highest level of formal education achieved.
    - *Operationalization:* to assess *educational level* participants responded to 8-items relating to completed educational program and year of graduation. Specifically, participants were asked to indicate yes or no for each of the following four levels of education: diploma/ certificate, bachelor's degree, master's degree, and

PhD/PharmD. Respondents who indicated yes (for any of the education levels) were coded with a 1, no was coded as a 2 and missing was coded as a 9. If they responded yes to a particular level of education they then indicated the year of graduation (open-ended question). The year of graduation was coded as specified (e.g., graduated in 1990 was coded as 1990). If they answered no to a particular level of education, the year was coded as 8888 (not applicable), or if the year was missing (no answer given) they were coded as 9999. In my study, I operationalized this variable as *highest educational level,* whereby PhD was considered the highest education level and diploma/certificate the lowest. Therefore, I recoded this variable as follows: diploma/certificate = 1; bachelor's degree = 2; master's degree = 3; PhD = 4 and missing = 9. Thus, nurses who have a bachelor's degree and a master's degree were coded as a 3.

- *Employment status:*
    - *Definition:* employment as full-time, part-time or casual.
    - *Operationalization:* single item with three categorical response options was used in the *TREC* and *TROPIC* surveys. The item was as follows: "What is your employment status on this [unit/facility]? Full-time, Part-time, or Casual" (check one). Participants who indicated that they worked full-time were coded with a 1, part-time coded with a 2, causal with a 3 and missing with a 9. For participants who identified themselves as working casual, they were also asked the open-ended question: "How many shifts, on average, do you work in a month?" The range for this question was from 6-30 (e.g., if the participant indicated that 6

shifts were worked, they were coded with a 6); participants who answered full-time or part-time to the first item were coded as 88 (not applicable) and missing data was coded as 99.

- *Sex:*
    - *Definition:* either male or female.
    - *Operationalization:* single item with two categorical response options was used in the *TREC* and *TROPIC* surveys to indicate the sex of the participant. The item was as follows: "What is your sex? Male or Female" (check one). Participants who indicated they were male were coded as 1 and females coded as 2. Missing data were coded with a 9. In my study, I recoded males as 0 and females as 1.

- *Nursing specialty:*
    - *Definition:* work setting - either adult LTC or pediatric acute-care.
    - *Operationalization:* I derived this variable based on inclusion into the two different studies (*TREC* and *TROPIC*). Nurses that participated in the *TREC* study worked in adult long-term care and *TROPIC* nurse participants worked in pediatric acute-care. Therefore, I categorized these nurses as working in two different specialties, namely adult LTC and pediatric acute-care. I coded the *TREC* nurse participants with a 0 and *TROPIC* nurses with a 1.

- *Number of years worked:*
    - *Definition:* number of years worked in current role.

- *Operationalization:* participants were asked: "How long have you worked in your current role?" Responses were captured as both the number of years and months in open-ended format as specified by the participant. Missing data for either months or years was coded as 99.

Data Analysis

Data analyses were conducted according to a pre-described protocol (Appendix A). The two datasets were combined into a new dataset so that the two groups of nurses could be compared and contrasted. Descriptive statistics (e.g., range, mean, standard deviations, frequency counts, etc.) were used to describe individual registered nurse demographic information and survey variables. Cronbach's alpha coefficient was used to report reliability of the scales. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity. To explore the relationship between problem solving perceptions and CRU, correlation analysis and multiple regression modelling was completed. Statistical significance was assigned at the $p < 0.05$ level. The analyses were conducted using IBM SPSS version 22.0 within a secure virtual environment (the University of Alberta's Health Research Data Repository).

Summary

This thesis research study focused on the relationship between problem solving and CRU in two discrete sets of registered nurses. A secondary analysis of cross sectional quantitative data was completed to address the research questions. The PARIHS framework and the Diffusion of Innovations theory along with current literature guided the variable selection. The results of the

study are presented in the manuscript in Chapter 2 with further discussion presented in Chapter 3.

Figure 1. *Diffusion of Innovations Theory* [29]

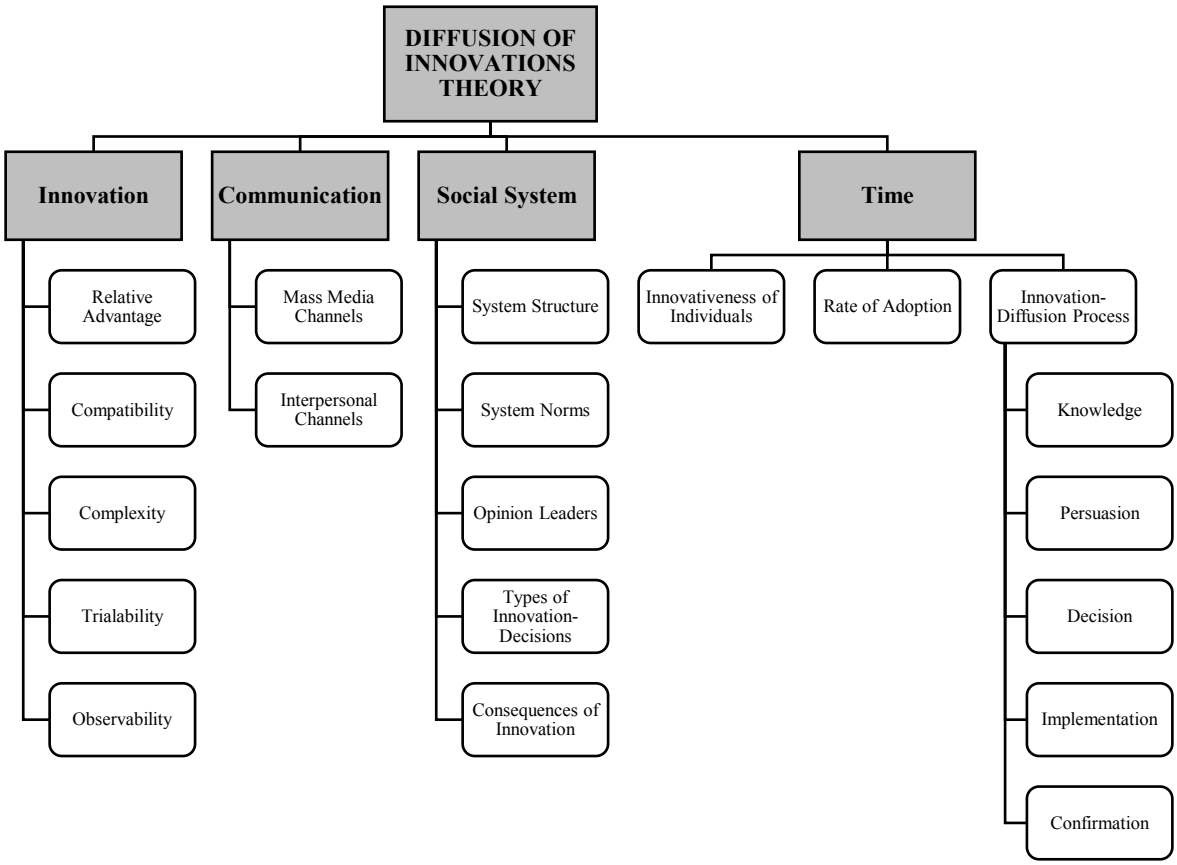


Figure 2. *Promoting Action on Research Implementation in Health Services (PARIHS) framework* [34]

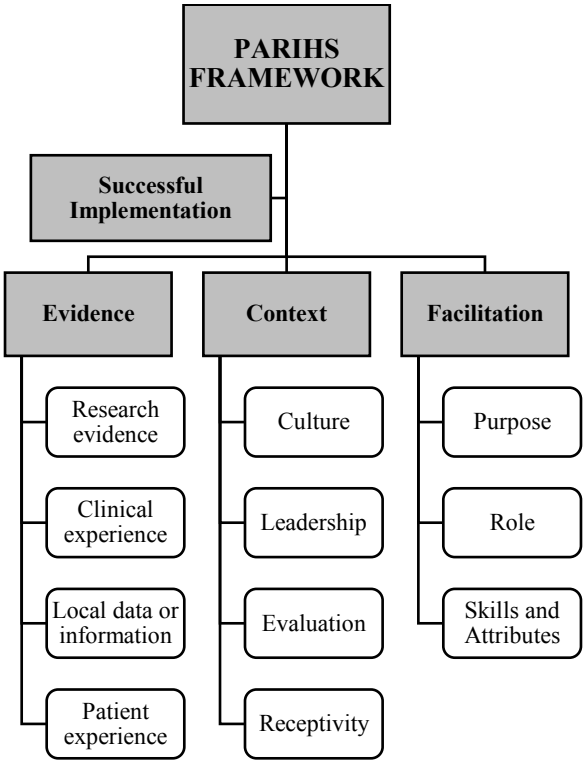
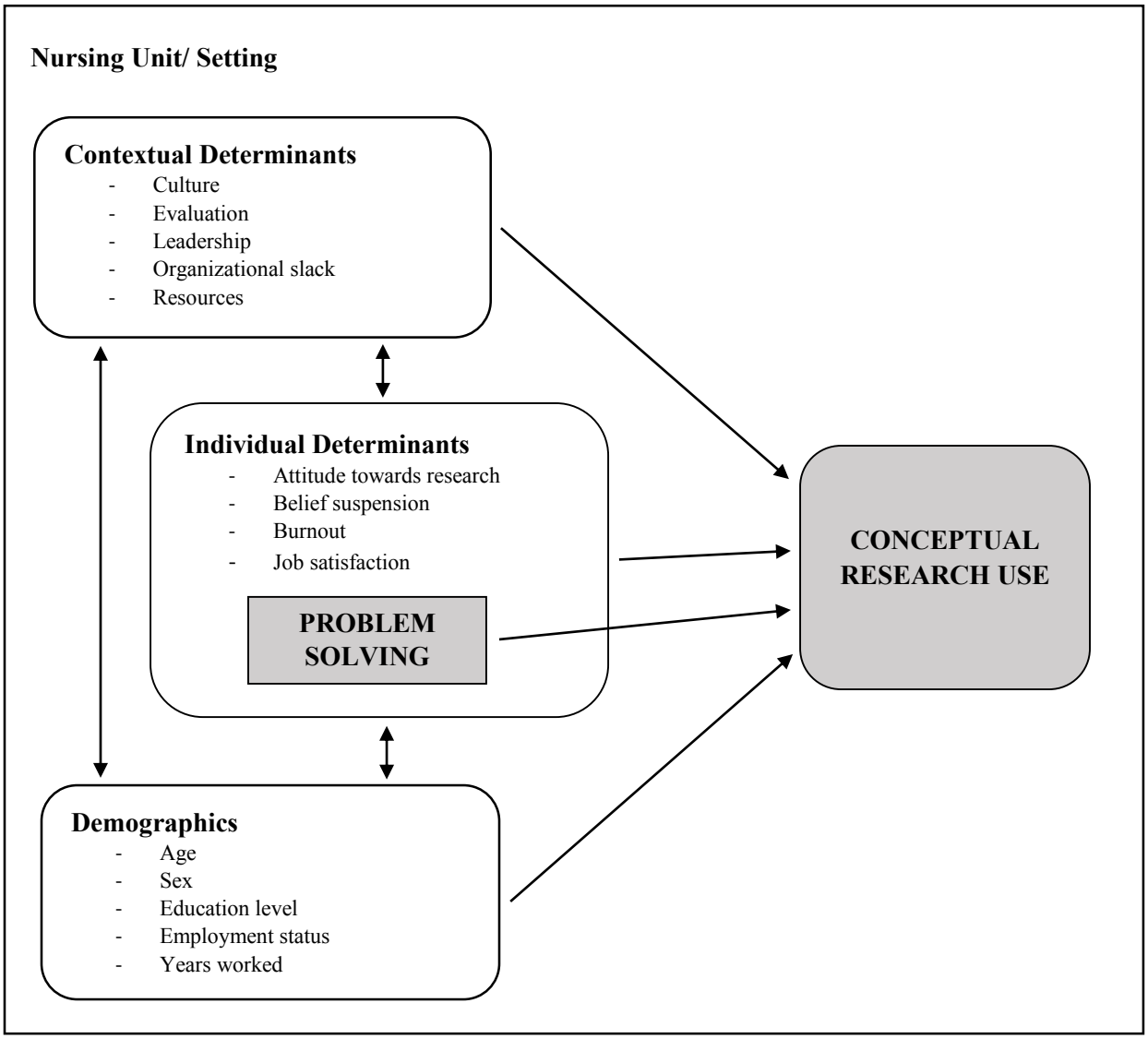


Figure 3. *Research Model*



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CHAPTER 2: Problem Solving and Conceptual Research Use in Registered Nurses: A Cross-Sectional Study

This chapter will be submitted as a manuscript for publication in the International Journal of Nursing Studies.

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Abstract

*Background***:** Nursing care affects patient outcomes. Nurses that are effective problem solvers and are better users of research are more likely to provide safe and quality care. However, the relationship between problem solving and research use among nurses is not clear.

Objective: To explore the relationship between self-perceived problem solving ability and conceptual research use in registered nurses working in adult long-term care and pediatric acute-care settings.

Design: A secondary analysis of cross-sectional quantitative data.

Methods: Using survey data previously collected from two longitudinal research programs, *Translating Research in Elder Care* and *Translating Research on Pain in Children* we used bivariate and multivariate techniques to address our objective. We measured problem solving using a 10-item scale. We measured conceptual research use in two ways, with a single-item question and a 5-item scale. We compared problem solving and conceptual research use scores in long-term care nurses (n = 160) and pediatric acute-care nurses (n = 766) using t-tests. Variables known to influence research use were included in regression analyses as control variables.

Results: Long-term care and pediatric nurses' scores did not differ on either the problem solving or conceptual research use scales. Conceptual research use (single item) scores were significantly different (t = -2.312; $p < 0.05$). There was a small but significant correlation between problem

solving and conceptual research use (single item) in both long-term care (r = 0.200) and pediatric nurses (r = 0.168). Problem solving was a significant predictor of conceptual research use (single item) but only in the pediatric nurses. The two measures of CRU did not behave consistently in the analyses.

Conclusions: Our results suggest a relationship between problem solving and conceptual research use in pediatric nurses, that is, pediatric nurses with more effective problem solving abilities may be more likely to use research to change their way of thinking. More research is needed to fully understand this relationship.

What is already known about this topic?

- Effective problem solving abilities and research use in practice have both separately been linked to improved patient outcomes
- The relationship between problem solving and conceptual research use in registered nurses has not been studied

What this paper adds

- There is a small but significant correlation between problem solving and conceptual research use in nurses
- Problem solving is a significant predictor of conceptual research use in pediatric nurses

1. Introduction

Nursing care affects patient health outcomes either positively or negatively. In Canada, nurses are the largest group of healthcare professionals and provide the majority of care to patients [1, 2]. Consequently, there are numerous potential opportunities for nurses to positively influence care outcomes or to make decisions that result in harm or adverse events. Of the estimated 7.5% of patients that experience an adverse event while in the hospital annually, approximately half of these adverse events are preventable [3]. Nurses have an integral role in mitigating adverse events and ensuring safe quality care is provided to patients. Furthermore, nurses are responsible for responding to, planning, and providing care in response to changing patient situations. This can be achieved by nurses continually ensuring that they are using effective problem solving skills and research in practice.

Engaging in effective problem solving has been identified as a necessary nursing competence for safe quality care [4, 5]. Problem solving is defined as the means by which an individual employs cognitive processes, such as decision making and critical thinking, acquired through previous knowledge, skills, and understanding, to resolve difficult situations [6]. Generally, successful problem solvers have a clear understanding of the problem or situation, are less impulsive and less likely to avoid problems, and have a systematic and effective approach to finding a solution [5]. These characteristics of successful problem solvers have clear benefits in nursing practice. Safe nursing practice depends on the nurse's ability to make appropriate assessments, to recognize patient health problems, and develop evidence-based care plans to address those problems [7]. Nurses with poor problem solving skills may fail to identify and respond to a patient experiencing life-threatening symptom and/or choose the wrong solution or intervention for a clinical problem, which may ultimately lead to an adverse event.

Research use is also believed to contribute to improved clinical decision making and increased delivery of high quality care in nursing [8]. Research use is defined as the implementation of research findings in practice [9, 10]. Increased research use has been linked to decreased adverse outcomes in patients [11]. Integrating research into clinical practice is the current standard within healthcare disciplines [12]. Nurses are expected to use research in their practice, regardless of their educational preparation [8]. However, several researchers have reported that the uptake of research findings into healthcare professional practice, including nursing, is delayed and sporadic [13, 14]. This phenomenon is generally referred to as the research-practice gap. By not incorporating current research into their practice, nurses reduce their ability to respond effectively and safely to new patient problems, conditions, and situations as they arise [4].

Having identified the critical need for nurses that are effective problem solvers who consistently use research in practice, nursing education programs have sought to foster these attributes in their students. However, we do not know if these problem solving skills taught in the classroom equate to more research use in practice. Furthermore, we do not know if nurses with higher self-reports of their problem solving abilities use more research in practice. To our knowledge no study has examined the relationship between problem solving ability and research use in registered nurses. Thus, the purpose of this study is to: a) understand problem solving ability and conceptual research use (CRU) in registered nurses; b) determine if and how these attributes vary based on context; and c) explore the relationship between problem solving ability and CRU among registered nurses.

2. Theoretical Framing

Our study was guided by a combination of two theoretical frameworks: Rogers' Diffusion of Innovations theory [15] and the Promoting Action on Research Implementation in Health Services (PARIHS) framework [16]. Both this theory and framework have previously been used to study research use in nursing. Diffusion of Innovations theory seeks to explain the spread of new ideas or research using four basic components: the innovation, communication channels, a social system and time [15]. Thus, diffusion occurs as a result of a new idea or new research being communicated by members of a social system over a period of time [17]. We, like other scholars have done in the field of nursing, have made the assumption that research utilization is analogous to innovation diffusion. Within this theory, our study is situated in the innovation-diffusion process, whereby the theoretical link between both problem solving, as an element of *decision*, and research utilization, as an element of *implementation*, has been proposed.

In the PARIHS framework, three elements (evidence, context, and facilitation) are considered necessary for the successful implementation of research into practice [16, 18-21]. Successful implementation is a function of evidence, context, and facilitation and the interrelationships between these three elements [22]. As a result of these three elements, the effect of an implementation intervention may be entirely different in different settings [22].

The Diffusion of Innovations theory and the PARIHS framework provided a guiding framework to explore both the individual and contextual elements of this research study and to substantiate our choice of both independent and dependent variables (see Figure 3). However, while our study does incorporate concepts from these two perspectives to guide the empirical

analysis, it is not an empirical test of either the Diffusion of Innovation theory or the PARIHS framework.

Insert Figure 3 about here

3. Design

We conducted a secondary analysis of cross-sectional data collected from two longitudinal research programs: *Translating Research in Elder Care* (*TREC*) collected in 2010 and *Translating Research on Pain in Children* (*TROPIC*) collected in 2011.

4. Methods

The analytical models that we used included correlation analysis and regression modelling to explore the relationship between problem solving perceptions and CRU in registered nurses. The data were also analyzed to see if two cohorts of registered nurses, those working in adult long-term care (LTC) and those working in pediatric acute-care, differed in their problem solving ability and CRU scores. Ethical approval was obtained for the original studies from the appropriate Institutional Review Boards at each participating institution and from the Universities with which the investigators were affiliated. We also obtained ethical approval from the University of Alberta Health Research Ethics Board (Pro00038743) for this secondary study.

4.1 Settings

In *TREC*, data were collected from healthcare providers in 36 LTC facilities throughout the Canadian Prairie Provinces (Alberta, Saskatchewan and Manitoba). The 36 *TREC* sites had 30 urban and 6 rural care facilities for a total of 103 resident care units (89 urban resident care units). Data in the *TROPIC* study were collected from healthcare providers in 8 acute-care

pediatric hospitals across Canada. The 8 pediatric hospitals had 32 patient care units (4 per hospital); these units were medical, surgical, or critical care.

4.2 Participants

In both the *TREC* and *TROPIC* studies, registered nurses working in the selected participating facilities were invited to participate if they met the inclusion criteria. In *TROPIC*, registered nurses met the inclusion criteria if they had worked (full-time, part-time, or casual) on the unit for a minimum of 6 months. The inclusion criteria for registered nurses participating in *TREC* included a) had to have worked for at least 3 months and were presently working on the unit; and b) had worked a minimum of 6 shifts per month on the unit. In both the *TREC* and *TROPIC* research projects, students were excluded.

4.3 Surveys

Online surveys were used to collect data from registered nurses in both the *TREC* and *TROPIC* studies. The surveys were developed and tested by the original research investigators and were nearly identical having been adapted for either a pediatric or LTC setting. Information related to work environment, research use, decision-making, information sharing, organizational resources and processes, health and well-being, and demographic information were captured by the survey questions. Participants were given a special code, which enabled them to access and complete the online survey. All surveys were conducted in English or French.

4.4 Measures/ Study Variables

4.4.1 Dependent Variable – Conceptual Research Use

The dependent variable assessed in this study was CRU. Conceptual research use is defined as the use of research to change one's thinking or understanding, but may not necessarily change one's action [10]. This variable was measured in both *TREC* and *TROPIC* surveys using

both a single item question and a 5-item scale. All of the CRU items were scored using a 5-point frequency scale from '10% or less of the time' to 'almost 100% of the time.' For the single item, participants were provided with the definition of CRU and asked "On your last typical work day, how often did you use research in this way?" For the scale, participants were asked "How often did research findings do any of the following?" Examples of the CRU scale items are: give new knowledge, raising your awareness, changing your mind – all relating to care of the resident/ patient. The overall score for the CRU scale was derived by taking the mean of the 5-items. Possible range for the final CRU score is 1-5; with higher values indicating higher levels of CRU. The CRU scale has previously demonstrated an acceptable level of reliability (Cronbach's alpha of 0.89) and validity when administered to healthcare aides [23, 24].

4.4.2 Independent Variables

Variable of Central Interest – Problem Solving

For the independent variable of central interest, problem solving, we used an abbreviated version of Heppner's Problem Solving Inventory [25] in both studies. Of the 35-items in the original Problem Solving Inventory, the 10-items with the highest factor loadings were chosen to derive this abbreviated scale [26]. Each of the 10-items were scored on a 5-point Likert-type scale ranging from 'strongly disagree' to 'strongly agree.' The mean of the 10-items, was used to create a derived score for this variable. The overall possible range of scores was from 1-5; higher total scores indicate more positive perceptions of problem solving abilities. This abbreviated scale has previously shown good reliability (Cronbach alpha = 0.74) [26].

Control (Explanatory) Variables

Demographic variables (age, sex, educational level, employment status, nursing specialty and number of years worked) were used as control variables. Additional control variables,

known to be related to research utilization, included: attitude towards research, belief suspension, burnout, and job satisfaction [26-28]. Last, contextual variables (culture, evaluation, interactions, leadership, organizational slack, and resources) measured by the Alberta Context Tool (ACT) were also used as control variables [29-32]. Details on the control variables, including definitions, measurement, and psychometric properties are presented in Table 1.

Insert Table 1 about here

4.5 Data Analyses

All analyses were conducted using SPSS version 22.0 within a secure virtual environment (the University of Alberta's Health Research Data Repository). The *TREC* and *TROPIC* datasets were combined into a new single dataset for the analyses. Descriptive statistics (e.g., range, mean, standard deviations, frequency counts, proportions) were used to describe individual registered nurse demographic information and survey variables. Cronbach's alpha coefficient was used to report reliability of the scales. Preliminary analyses were performed to assess assumptions of normality, linearity and homoscedasticity.

We used *t*-tests to determine if mean problem solving scores and CRU (the scale and the single item analyzed separately) scores were different between LTC nurses and pediatric acute-care nurses. Pearson's correlation coefficient was used to explore the association between problem solving ability and CRU. Separate analyses were conducted for the single item and scale CRU variables in each group of registered nurses. Multiple regression analyses were then done to understand the predictive nature of problem solving ability on CRU. The regression analyses were conducted in a block-wise fashion with 'nursing area' as a variable to account for the nested nature of the data (e.g., medicine, surgery, and critical care in the pediatric nurses; rural and urban in the LTC nurses). Two separate regression analyses were conducted for each group

of nurses, one for each of the two CRU dependent variables (scale and single item) both using problem solving ability as the main independent variable of interest. Statistical significance for all analyses was assigned at the $p < 0.05$ level.

5. Results

5.1 General Characteristics of the Sample

Pediatric Sample

Of the 766 registered nurses surveyed that were working in pediatric acute-care settings, 323 (42.2%) worked in critical care units, 294 (38.4%) in medicine units, and 149 (19.5%) in surgery units. The majority of these nurses were female (n = 722; 94.3%), between the ages of 25-29 years old (n = 197; 25.7%), had a Bachelor's degree (n = 500; 65.3%) and worked full-time (n = 464; 60.6%).

Long-term Care Sample

The number of adult LTC registered nurses was less (n = 160), with 19 (11.9%) nurses working in rural LTC facilities and the remaining 141 (88.1%) working in urban facilities. Like the pediatric nurses, the majority of the LTC nurses were female (n = 144; 90%). The pediatric and LTC groups were significantly different in terms of age (t = 11.67; p = 0.00), education level (t = -16.60; p = 0.00), employment status (t = 7.12; p=0.00), and years worked (t = 2.38; $p <$ 0.05). The LTC nurses were older and a majority had completed a diploma level of education. The majority of the LTC nurses also worked part-time and generally had worked for a longer period of time compared to the pediatric group. A summary of the demographic characteristics for the participants is provided in Table 2.

Insert Table 2 about here

5.2 Reliability of the Scales

In this study, the abbreviated problem solving inventory showed good internal consistency with a Cronbach alpha coefficients of 0.72 in the LTC nurses and 0.76 in the pediatric nurses. The CRU scale also had good internal consistency with alpha coefficients of 0.97 and 0.98 for the pediatric and LTC nurses respectively.

5.3 Problem Solving and Conceptual Research Use Scores

Table 3 outlines the sample's means, ranges and standard deviations for the problem solving scores and CRU scores. The problem solving scores and the CRU scale scores were not significantly different between the LTC and pediatric nurses. However, the CRU (single item) was significantly different between the LTC and pediatric nurses ($t = -2.31$; $p < 0.05$). When the LTC nurses were divided into two subgroups, those working in urban facilities and those working in rural facilities, and compared, no differences between these groups with regards to problem solving scores or CRU scores (scale and single item) was observed. The same pattern was noted when the pediatric nurses were assessed by speciality (medicine, surgery, critical care). The problem solving scores and CRU scores (scale and single item) were not significantly different among these speciality groups.

Insert Table 3 about here

5.4 Correlation Analyses

There was a modest but significant positive correlation between the problem solving scale and CRU (single item) in both the pediatric nurses ($r = 0.168$; $p < 0.05$) and LTC nurses ($r = 0.200$; $p < 0.05$). However, the correlation between the problem solving scale and the CRU (scale) was not significant in either group of nurses.

5.5 Regression Analyses

All four of our final regression models were significant; the results of these analyses are presented in Table 4. We conducted our regression analyses using a block-wise method with each analysis containing four models. As problem solving was only a significant predictor in one of our analyses, we will focus our attention to that particular analysis (CRU (single item) in the group of pediatric nurses) and provide a general overview of the other three analyses.

Insert Table 4 about here

5.5.1 Conceptual Research Use (single item measure) in Pediatric Nurses

Problem solving, our main variable of interest was entered in Model I. This model explained 2.8% of the variance in CRU, indicating that pediatric nurses with a higher level of self-perceived problem solving ability also had a higher level of self-reported CRU. In Model II we entered a block of demographic and unit variables in addition to problem solving and the total variance of the model increased to 7.7% ($p < 0.05$). In this model, problem solving (*beta* = 0.171) remained a significant predictor, and sex (*beta* = -0.099), having a bachelor's degree (*beta* = 0.136), and working part-time (*beta* = -0.110) were also statistically significant predictors of CRU. In Model III, we added the block of individual variables thought to influence CRU (attitude towards research, belief suspension, Maslach Burnout Inventory scales [33], and job satisfaction). The total explained variance for Model III was 10.4% ($p < 0.05$). In this model, problem solving (*beta* = 0.112), sex (*beta* = -0.099), having a bachelor's degree (*beta* = 0.134), and working part-time (*beta* = -0.090) remained significant predictors of CRU. In addition to these variables, age (*beta* = 0.157), number of years worked on the unit (*beta* = -0.112), belief suspension (implementation) (*beta* = 0.147), and job satisfaction (*beta* = 0.098) were all associated with higher levels of CRU. In the final model, we added the organizational context

variables and saw the explanatory power of the model increase to 14.3% ($p < 0.05$). The *beta* coefficients for problem solving (0.095), age (0.131), sex (-.097), having a bachelor's degree (0.099) and belief suspension (implement) (0.114) all decreased slightly with the addition of the organizational context variables, but still remained significant predictors of CRU. Higher levels of evaluation (*beta* = 0.092), informal interactions (*beta* = 0.125), and resources (*beta* = 0.110) were also related to higher levels of reported CRU. The number of years worked on a unit and working part-time, however, were no longer significant in Model IV.

5.5.2 Remaining Three Regression Analyses

The remaining three analyses were all significant: a) CRU (scale) in pediatric nurses (*adjusted* $R^2 = 0.192$); b) CRU (single item) in LTC nurses (*adjusted* $R^2 = 0.206$); and c) CRU (scale) in LTC nurses (*adjusted* $R^2 = 0.293$). However, when all the variables were entered into each of these final models, problem solving was not a significant predictor in any of them. Problem solving was a significant predictor of CRU (single item) in the LTC nurses for the first two models, but when the individual variables thought to influence CRU were added, it was no longer significant. As expected, several other variables emerged as significant predictors of CRU. Attitude towards research (*beta* = 0.330; $p < 0.05$) was the only predictor of CRU (single item) in the LTC nurses. Structural and electronic resources was a significant predictor of CRU (scale) in both LTC and pediatric nurses. Additionally, part-time employment (*beta* = -0.072), number of years worked on the unit (*beta* = -0.121), culture (*beta* = 0.131), and evaluation (*beta* = 0.158) were significant predictors of CRU (scale) in the pediatric nurses.

6. Discussion

This study focused on investigating the relationship between problem solving ability and CRU in registered nurses. Our findings were mixed.

We anticipated that the pediatric nurses and LTC nurses would score differently on both problem solving ability and CRU because their work roles are very different; with pediatric nurses providing more traditional bedside care in acute-care settings and LTC nurses being in more of a leadership role with less direct bedside care in residential LTC settings. We found that problem solving scores between the two groups of nurses were not significantly different, indicating that self-perceived problem solving ability did not differ based on work setting/ role in this study despite the difference between the two groups of nurses with regards to highest education level. We had speculated that education level would affect problem solving ability as suggested by the literature [7, 34, 35]. In addition, we found conflicting results with regards to CRU. While the two groups of nurses had similar scores on the CRU scale and were not significantly different, the opposite was true for the single items scores. The two groups of nurses were significantly different in terms of the CRU single item. Our results only partially support the PARIHS framework, which proposes that context affects the use of research in practice [16].

We further hypothesized that problem solving ability and CRU, both the single item and the scale, would be significantly correlated. However, we found that the problem solving scale scores were only significantly correlated with the CRU (single item) in both the adult LTC and pediatric acute-care nurses. Although the correlation between problem solving and CRU was small, it provides a preliminary suggestion that registered nurses who perceive themselves as successful problem solvers may be more likely to use research to change their way of thinking.

Our results parallel what other researchers who have studied critical thinking, a concept similar to problem solving, have found. Studies investigating the relationship between critical thinking and CRU have also found small significant positive correlations in registered nurses ($r = 0.27$) [36] and nurse educators ($r = 0.205$) [12].

Even though our regression results were not consistent across the four analyses, our results were similar to previous research which has identified that both individual [26-28] and contextual factors [37-41] are predictors of research use. Problem solving was related to CRU (single item) in pediatric nurses after controlling for demographic, unit, individual and contextual variables. Thus, pediatric nurses with higher levels of self-perceived problem solving were more likely to use research in practice. We did expect that more variables would be significant predictors of CRU. In both of our regression analyses involving the LTC nurses, only one significant predictor was found. In three of our analyses, structural and electronic resources was a significant predictor of CRU; this finding is consistent with what other researchers have found [40]. We expected attitude towards research to be a significant predictor in all regressions as others have reported the importance of attitude towards research in predicting research use [27, 28].

Conceptual research use, in this study, was measured using two approaches: a 5-item scale and a single item question. The two measures of CRU were significantly correlated in both the LTC and pediatric nurses ($r = 0.59$, $p = 0.00$; $r = 0.40$, $p = 0.00$ respectively). However, we expected the level of correlation to have been even higher. This moderate, instead of high, correlation may partially explain why these two measures of CRU behaved differently in the analyses. These results also suggest that the CRU (single item) and CRU (scale) may not be measuring the same concept. In two reports using the CRU scale with unregulated healthcare

aides, Squires *et al*. reported early evidence of validity [23] but that the precision of the scale may differ between high and low trait levels [24]. Validity assessments with registered nurse samples have not been reported and the scale may not perform as well with this population.

7. Conclusions

This examination of the relationship between problem solving ability and CRU adds to the limited research in this area. Our results showed an inconsistent relationship between problem solving and two measures of CRU in registered nurses. Additional research to assess the validity of the CRU measures in nurse samples is warranted. Once this has been completed, additional work to compare the two measures to determine if one is superior for research purposes is needed. A critical examination of the precision of the abbreviated problem solving scale using item response theory would benefit researchers wishing to use this instrument. In future studies, researchers should consider developing interventions aimed at improving problem solving ability and examine whether those interventions also improve research use. Improving problem solving ability and research use in nursing practice may ultimately lead to improved patient care and health outcomes and is therefore, a priority for further inquiry and research.

8. Limitations

Several limitations are present. First, the original data are self-report which has inherent limitations such as the risk for recall and social desirability bias. Second, the relatively low amount of explained variance suggests that there are still other factors/variables that need to be included in models. Third, although our sample came from a variety of healthcare sites/facilities our results should not be generalized beyond these settings and groups of nurses. Fourth, while

our blocked regression analysis is an appropriate method for dealing with nested data, more rigorous statistical techniques (e.g., generalized estimating equations) should also be considered. Finally, even though the abbreviated problem solving inventory for this study showed adequate reliability, its validity requires further assessment. Therefore, our findings must be interpreted with caution.

9. Acknowledgements

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10. Contributions

CLM conducted the literature review, the data analysis, and wrote the manuscript. CAE was the supervisory author and provided critical feedback. All authors participated in reviewing the manuscript and manuscript edits.

Figure 3. *Research Model*

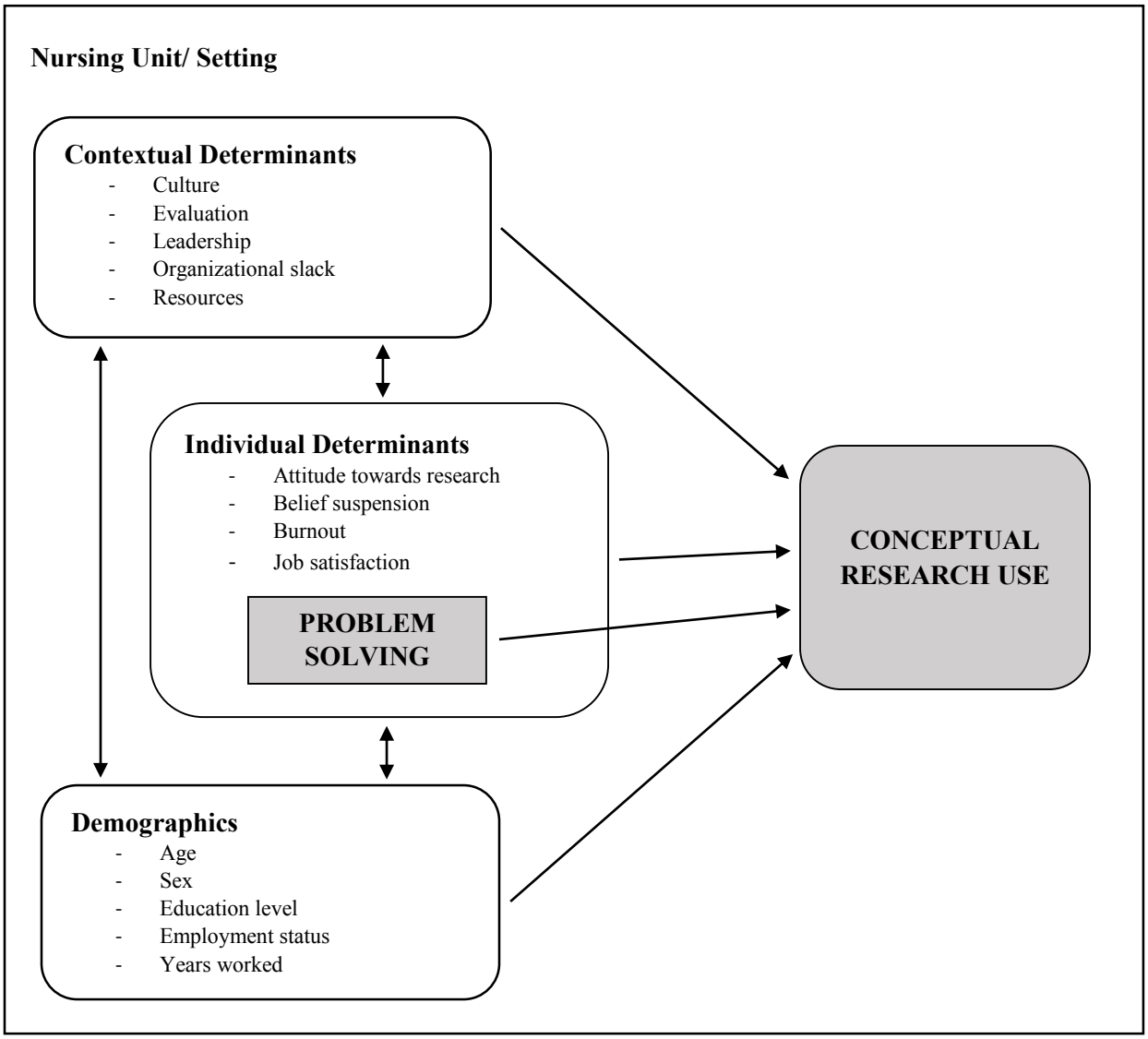

Table 1. *Control variables used in multiple regression analyses*.

Concept	Definition	Operationalization
Demographic Variables		
Age	Age in years old	12 categories to select from: < 20 years, 20-24 years, 25-29 years, 30-34 years, 35-39 years, 40-44 years, 45-49 years, 50-54 years, 55-59 years, 60-64 years, 65-70 years, > 70 years
Sex	Nurse Sex	Male or female
Highest Education Level	Highest level of education achieved	5 categories: none, diploma/certificate, bachelor's degree, master's degree, PhD
Employment Status	Employment as either full-time, part-time or casual	3 categories: full-time, part-time, or casual
Number of Years Worked on Unit	Amount of time worked on current care unit in years	Exact numerical value provided by participants
Unit/ Facility Variables		
Facility (Long-term care nurses only)	Facility location either: urban or rural or urban	Urban facilities were located in designated health regions (Alberta – Edmonton, Calgary, East central; Manitoba – Winnipeg; Saskatchewan – Regina-Qu'Appelle or Saskatoon)
		Rural facilities were located in a radius of between 100km and 200km from Regina or Saskatoon and with populations of 10,000 people or less
Unit (Pediatric nurses only)	Type of pediatric unit: Medicine or Surgery or Critical Care	At each participating pediatric hospital, nurses from a combination of medical, surgical, and critical care units were surveyed and classified by unit category
Individual Variables		
Attitude Towards Research	Expressed attitude towards research	6-items scored on a 5-point Likert agreement scale (1= strongly disagree to 5= strongly agree)
Belief Suspension (willingness and implementation)	The degree to which a nurse is able to suspend previously held beliefs in order to implement a change based on research	Willingness (to suspend the belief): 3-items scored on a 5-point Likert agreement scale (1= strongly disagree to 5= strongly agree)
		Implementation (actual suspension of the belief): 3-items scored on a 5-point Likert agreement scale (1= strongly disagree to 5= strongly agree)
Maslach Burnout Inventory (Exhaustion, Cynicism, and Efficacy)	A syndrome of emotional exhaustion and cynicism brought about by work stress	Exhaustion: 3-items scored on a 7-point Likert frequency scale (0= never to 6= daily)
		Cynicism: 3-items scored on a 7-point Likert frequency scale (0= never to 6= daily)
		Efficacy: : 3-items scored on a 7-point Likert frequency scale (0= never to 6= daily)
Job Satisfaction	The degree to which an individual is fulfilled by the work they do	1-item using a 5-point Likert agreement scale (1= strongly disagree to 5= strongly agree)
Context Variables (ACT)		
Culture	The way that 'we do things' on units; items generally reflect a supportive work culture	6-items scored on a 5-point Likert agreement scale (1= strongly disagree to 5= strongly agree)

Concept	Definition	Operationalization
Leadership	The actions of formal leaders in a unit that influence change and promote excellence in practice; items generally reflect emotionally intelligent leadership	6-items scored on a 5-point Likert agreement scale (1= strongly disagree to 5= strongly agree)
Evaluation	The process of using data to assess team performance and to achieve positive outcomes in units	6-items scored on a 5-point Likert agreement scale (1= strongly disagree to 5= strongly agree)
Formal Interactions	Formal exchanges that occur between individuals working on a unit through scheduled activities that can promote knowledge transfer	4-items scored on a 5-point Likert frequency scale (1= never to 5= almost always)
Informal Interactions	Informal exchanges that occur between individuals working on a unit that can promote knowledge transfer	9-items scored on a 5-point Likert frequency scale (1= never to 5= almost always)
Organizational Slack (Space, Time, Staffing)	Cushion of resources, which allows a unit to successfully adapt to internal or external pressures/changes	Space (availability and use of adequate space to provide care and share best practice knowledge): 3-items scored on a 5-point Likert agreement scale (1= strongly disagree to 5= strongly agree)
		Time (availability of time to provide care and share best practice knowledge): 4-items scored on a 5-point Likert agreement scale (1= strongly disagree to 5= strongly agree)
		Staffing (availability of adequate staffing levels to provide care): 3-items scored on a 5-point Likert agreement scale (1= strongly disagree to 5= strongly agree)
Structural and Electronic Resources	Structural and electronic elements of a unit that help team members to use research knowledge	11-items scored on a 6-point Likert frequency scale (1= never, to 5= almost always, 6= not available)

Table 2. *Description of samples*.

		Long-Term Care Nurses			Pediatric Acute-Care Nurses			
		Total	Urban	Rural	**Total**	Medicine	Surgery	Critical Care
		***n*=160**	*n*=141	*n*=19	***n*= 766**	*n*=294 (38.4%)	*n*=149 (19.5%)	*n*=323 (42.2%)
Sex, n (%)	Male	**13 (8.1)**	10 (7.1)	3 (15.8)	**43 (5.6)**	18 (6.1)	11 (7.4)	14 (4.3)
	Female	**144 (90)**	128 (90.8)	16 (84.2)	**722 (94.3)**	275 (93.5)	138 (92.6)	309 (95.7)
	Missing	**3 (1.9)**	3 (2.1)	0 (0)	**1 (0.13)**	1 (0.34)	0 (0)	0 (0)
Age, in years, n (%)	20-24	**6 (3.4)**	5 (3.5)	1 (5.3)	**64 (8.4)**	31 (10.5)	13 (8.7)	20 (6.2)
	25-29	**9 (5.6)**	5 (3.5)	4 (21.1	**197 (25.7)**	82 (27.9)	43 (28.9)	72 (22.3)
	30-34	**4 (2.5)**	4 (2.8)	0 (0)	**136 (17.8)**	53 (18.0)	28 (18.8)	55 (17.0)
	35-39	**25 (15.6)**	23 (16.3)	2 (10.5)	**73 (9.5)**	31 (10.5)	10 (6.7)	32 (9.9)
	40-44	**14 (8.8)**	13 (9.2)	1 (5.2)	**75 (9.8)**	33 (11.2)	14 (9.4)	28 (8.7)
	45-49	**18 (11.3)**	16 (11.3)	2 (10.5)	**78 (10.2)**	26 (8.8)	12 (8.1)	40 (12.4)
	50-54	**24 (15.0)**	22 (15.6)	2 (10.5)	**80 (10.4)**	23 (7.8)	13 (8.7)	44 (13.6)
	55-59	**25 (15.6)**	22 (15.6)	3 (15.8)	**46 (6.0)**	10 (3.4)	11 (7.4)	25 (7.7)
	60-64	**20 (12.5)**	17 (12.0)	3 (15.8)	**13 (1.7)**	3 (1.0)	4 (2.7)	6 (1.9)
	65-70	**15 (9.4)**	14 (9.9)	1 (5.3)	**2 (0.26)**	1 (0.34)	1 (0.67)	0 (0)
	>70	**0 (0)**	0 (0)	0 (0)	**1 (0.13)**	0 (0)	0 (0)	1 (0.31)
	Missing	**0 (0)**	0 (0)	0 (0)	**1 (0.13)**	1 (0.34)	0 (0)	0 (0)
Highest Level of Education, n (%)	None identified	**34 (21.3)**	29 (18.1)	5 (25.3)	**2 (0.26)**	0 (0)	1 (0.67)	1 (0.31)
	Diploma	**102 (63.8)**	92 (65.2)	10 (52.6)	**241 (31.5)**	78 (26.5)	56 (37.6)	107 (33.1)
	Bachelor's Degree	**24 (15.0)**	20 (14.2)	4 (21.1)	**500 (65.3)**	206 (70.0)	91 (61.1)	203(62.8)
	Master's Degree	**0 (0)**	0 (0)	0 (0)	**23 (3.0)**	10 (3.4)	1 (0.67)	12 (3.7)
	PhD	**0 (0)**	0 (0)	0 (0)	**0 (0)**	0 (0)	0 (0)	0 (0)
Employment Status, n (%)	Full-time	**49 (30.6)**	43 (30.5)	6 (31.6)	**464 (60.6)**	165 (56.1)	93 (62.4)	206 (63.8)
	Part-time	**94 (58.8)**	85 (60.3)	9 (47.4)	**270 (35.2)**	116 (39.5)	46 (30.9)	108 (33.4)
	Casual	**16 (10.0)**	12 (8.5)	4 (21.1)	**31 (4.0)**	12 (4.1)	10 (6.7)	9 (2.8)
	Missing	**1 (0.63)**	1 (0.71)	0 (0)	**1 (0.13)**	1 (0.34)	0 (0)	0 (0)
Years worked on unit, mean (SD)		**5.83 (6.22)**	5.45 (5.74)	8.65 (8.65)	**9.31 (8.476)**	8.11 (6.614)	7.95 (7.917)	11.03 (9.807)

Table 3. *Problem solving and conceptual research use scores*

		Problem Solving Scale Score mean (SD)	**CRU Single Item Score** mean (SD)	**CRU Scale Score** mean (SD)
Long-term Care Nurses	**Total**	3.869 (0.417)	3.250 (1.288)	2.637 (1.358)
	Rural	3.872 (0.468)	2.840 (1.068)	2.400 (1.278)
	Urban	3.868 (0.411)	3.310 (1.308)	2.668 (1.370)
Pediatric Nurses	**Total**	3.823 (0.356)	3.496 (1.198)	2.561 (1.193)
	Medicine	3.810 (0.350)	3.452 (1.238)	2.532 (1.213)
	Surgery	3.879 (0.361)	3.470 (1.228)	2.473 (1.162)
	Critical Care	3.809 (0.361)	3.548 (1.148)	2.628 (1.188)

Table 4. *Standardized beta coefficients of regression models.*

Variables	Long-term Care Nurses: CRU Scale				Long-term Care Nurses: CRU Single Item				Pediatric Nurses: CRU Scale				Pediatric Nurses: CRU Single Item			
	I	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**
Problem Solving	.148	.160	.085	.021	**.200***	**.180***	.010	-.036	.051	.057	.011	-.009	**.168***	**.171***	**.112***	**.095***
Age		.001	-.083	-.048		.113	.034	.030		.010	.041	.017		.113	**.157***	**.131***
Sex		-.002	.033	.036		-.159	-.085	-.075		-.063	-.057	-.054		**-.099***	**-.099***	**-.097***
Bachelor's Degree[a]		.015	.014	-.039		-.045	-.067	-.110		.067	.077	.025		**.136***	**.134***	**.099***
Master's Degree[a]		NA	NA	NA		NA	NA	NA		.004	-.003	-.008		.010	-.005	-.015
No Formal Education[a]		**.287***	**.222***	.095		.172	.070	-.019		-.003	-.004	-.006		-.032	-.025	-.027
Part-time Employment[b]		**-.195***	-.135	-.060		-.107	-.082	-.032		**-.113***	**-.100***	**-.072***		**-.110***	**-.090***	-.070
Casual Employment[b]		-.157	-.119	-.038		-.043	-.022	.017		-.048	-.042	.012		-.055	-0.52	-.024
Number of Years Worked on Unit		-.037	.033	-.009		.035	.100	.104		**-.131***	**-.130***	**-.121***		-.109	**-.112***	-.105
Rural Facility[c]		-.065	-.038	.013		-.109	-.075	-.061		NA	NA	NA		NA	NA	NA
Surgery Unit[d]		NA	NA	NA		NA	NA	NA		-.027	-.021	-.026		-.009	-.013	-.026
Critical Care Unit[d]		NA	NA	NA		NA	NA	NA		.053	.043	.047		.037	.021	.008
Attitude Towards Research			.151	.150			**.328***	**.330***			.041	.012			.059	.028
Belief Suspension-Willingness			-.169	-.066			**-.214***	-.172			-.059	-.039			.033	.038
Belief Suspension-Implementation			-.027	-.051			.130	.128			**.109***	.068			**.147***	**.114***
MBI-Exhaustion			.006	.027			.131	.167			.053	.007			.079	.040
MBI- Cynicism			.025	.024			-.151	-.170			**-.110***	-.029			-.087	-.029
MBI- Efficacy			.134	.062			.030	-.008			.042	.028			-.002	-.004
Job Satisfaction			**.217***	-.028			**.268***	.126			.077	-.007			**.098***	.071
ACT- Culture				.194				.118				**.131***				.001
ACT- Leadership				-.042				.051				-.038				-.005
ACT- Evaluation				.194				-.005				**.158***				**.092***
ACT- Organizational Slack: Staffing				.046				.091				-.003				.007
ACT- Organizational Slack: Space				-.060				-.030				.074				.031

Variables	Long-term Care Nurses: CRU Scale				Long-term Care Nurses: CRU Single Item				Pediatric Nurses: CRU Scale				Pediatric Nurses: CRU Single Item			
	I	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**
ACT- Organizational Slack: Time				-.083				-.042				-.066				-.010
ACT- Formal Interactions				.032				.080				-.011				-.016
ACT- Informal Interactions				.101				.061				.046				**.125***
ACT- Structural and Electronic Resources				**.296***				.125				**.256***				**.110***
R^2	.022	**.159***	**.250***	**.431***	**.040***	.119	**.302***	**.361***	.003	**.053***	**.089***	**.224***	**.028***	**.077***	**.128***	**.177***
Adjusted R^2	.014	**.096***	**.143***	**.293***	**.033***	.052	**.202***	**.206***	.001	**.037***	**.064***	**.192***	**.027***	**.062***	**.104***	**.143***

*: $p<0.05$
a: reference Diploma
b: reference Full-time employment
c: reference Urban
d: reference Medicine Unit
NA: Not applicable

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CHAPTER 3: Conclusions

Introduction

In the previous chapter I presented the manuscript portion of my paper-based thesis, reporting the major findings. The aim of my study was to investigate the relationship between self-perceived problem solving ability and self-reported conceptual research use (CRU) in two groups of registered nurses. In this chapter, I briefly summarize the main findings of my thesis research project. Additionally, I discuss the research, knowledge, practice, and theory implications as well as directions for future research. This chapter concludes with a discussion of the limitations of my research project.

Overview of Results

My findings were mixed; the results of my study only partially supported my hypothesis. The pediatric and long-term care (LTC) nurses' scores on the CRU (single item) were significantly different. No significant differences were found when problem solving scores or CRU (scale) scores were compared between the two groups. Additionally, there were no differences in problem solving scores or CRU (scale and single item) scores when the subgroups for the LTC nurses (rural vs. urban) and pediatric nurses (medicine vs. surgery vs. critical care) were compared. There was a small significant correlation between the problem solving scale and CRU (single item) in both the pediatric and LTC nurses. However, the correlation between the problem solving scale and the CRU (scale) was not significant in either group of nurses. All four of my final regression analyses were significant. However, problem solving was only a significant predictor in the group of pediatric nurses when CRU (single item) was used as the dependent variable. Other significant predictors in this analysis were: age, sex, having a

bachelor's degree, belief suspension (implement), evaluation, informal interactions, and resources. Overall, my results provide some preliminary evidence that a positive relationship between problem solving and CRU exists. However, more research is needed before more conclusive statements about this relationship can be made.

Contributions to Research

This thesis research study was the first, to my knowledge, that investigated the relationship between problem solving and CRU in two groups of registered nurses. Thus, this study helped to address an important gap in the literature. Although my findings were mixed, this study offered some preliminary insights into the nature of the relationship between problem solving and CRU. This study also highlighted the need for further research to test the psychometric properties of the scales used in this study.

Research has been done on CRU in the past several years to help understand how best to measure this concept. Although CRU was first reported in the 1970s, there are a limited number of research studies that have specifically examined CRU in nurses [1]. The majority of these studies use the Estabrooks' [2] single item measure to capture participants level of CRU [2-8] and these studies have shown variability and consistency of this measure in different contexts [1]. Squires *et al*. [9] investigated the psychometric properties of the CRU scale using data from a sample of healthcare aides. They recommended that a 4-item version of the CRU scale be used as a more accurate measure of CRU. Further research conducted on this scale by Squires *et al*. [1] indicated that the precision of the CRU scale may differ between high and low trait levels. However, the psychometric properties of the CRU scale in nurses has not been reported in the literature.

It is generally accepted that testing of an instrument, such as the problem solving scale or the CRU scale, requires assessment of its psychometric properties: a) reliability, b) validity, and c) acceptability. My study contributed to the limited knowledge of the psychometric properties of both the problem solving and CRU scales in nurses.

Reliability refers to the consistency of a scale when used repeatedly on a sample of individuals [10]. It is generally accepted that Cronbach alpha coefficients greater than 0.7 indicate acceptable reliability [10]. The CRU scale showed good internal consistency in my study; the Cronbach alpha coefficients for the CRU scale were 0.978 in the LTC nurses and 0.965 in the pediatric nurses. Other researchers have reported that this 5-item scale has previously shown acceptable reliability in healthcare aides (Cronbach's alpha = 0.894) [1, 9]. The abbreviated problem solving inventory also demonstrated acceptable reliability with Cronbach alpha coefficients of 0.720 in the LTC nurses and 0.761 in the pediatric nurses. In previous research, this problem solving scale had a similar Cronbach's alpha level of 0.74 in registered nurses [3]. Thus, the repeated acceptable reliability in this scale adds to our confidence in the consistency of measure. Research assessing the reliability of this problem solving scale in other healthcare professionals is needed to further substantiate the robustness of this measure.

Validity is the extent to which a measure actually measures what it is intended to [10]. The *Standards for Educational and Psychological Testing,* a framework that uses four sources of evidence for validation, is considered best practice in the field of psychometrics [11]. Within this framework all validity evidence contributes to the single concept of construct validity [9, 11]. The four sources of evidence are: a) content evidence; b) response processes; c) internal structure; and d) relations to other variables [1, 9, 11]. The CRU scale has undergone validity

testing in healthcare aides [1, 9], but the same testing has not yet been conducted on nurses. Nor has rigorous validity testing been completed on the abbreviated problem solving scale.

My study contributes to the validity testing of the CRU scale by contributing evidence with regards to 'relations to other variables'. In this study, CRU, my dependent variable, was measured using two approaches: a 5-item scale and a single item question. When I originally chose to use both measures I did not anticipate that the two measures would behave so differently and inconsistently in the analyses. The two measures of CRU were not as highly correlated as I had expected (r= 0.588, p= 0.000 in the LTC nurses; r= 0.397, p= 0.000 in the pediatric nurses). Thus, these results suggest that the CRU (single item) and CRU (scale) may in fact not be measuring the same concept. However, the results of this study are not conclusive enough to identify which of the two measures best measured CRU as a concept. My study further contributes to the validity evidence of this scale by reporting the relationship between CRU and external variables (e.g., problem solving and context variables). Further inquiry into the validity of the CRU (scale) in both nurses and other healthcare professionals is needed before any changes can be made to improve the scale.

As well, more research needs to be done to ensure the validity of the abbreviated version of the Problem Solving Inventory. Heppner's original Problem Solving Inventory [12] has been tested and used in a number of different contexts and individuals [13]. Acceptable estimates of concurrent, discriminant, and construct validity, for the original Problem Solving Inventory, have all been reported [12]. The abbreviated version of the Problem Solving Inventory, used in my study, has not undergone such rigorous testing. Thus, my study contributes some preliminary evidence towards validation of this abbreviated scale. Once again, my study adds to 'relations to other variables' as a source of evidence for validation of the abbreviated problem solving scale

by reporting its relationship to CRU. Researchers, using this scale in the future, would benefit from testing the original scale against the abbreviated scale to determine how or if the results differ; thus, providing more validation evidence. Additionally, conducting a factor analysis to better understand the internal structure of the abbreviated scale would be of benefit to future users of this instrument.

Acceptability refers to how easy an instrument is to use [9]. My study did not contribute to the acceptability of either the problem solving scale or the CRU scale because it was a secondary analysis. However, this is another area that could be explored in the future.

Contributions to Nursing Knowledge

My study contributed to nursing knowledge in three ways. First, my study offered some insight into how nurses perceive their problem solving ability. Even though effective problem solving has been identified as a necessary competence for nursing, the quantity of literature on nurses' perceptions of their problem solving ability is limited to a few studies [3, 14-18]. Therefore, my study contributes to this limited body of knowledge on problem solving in practicing nurses. In my study, I found that the mean problem solving scores of the pediatric nurses to be 3.823 and LTC nurses to be 3.869. However, more research needs to be conducted on this scale before conclusive statements can be made about what these scores actually mean and what constitutes a clinically meaningful difference. Neither the original Problem Solving Inventory nor the abbreviated version used for my study quantify what an individual's score actually means or at what point an individual can be labelled an effective versus ineffective problem solver. This distinction would help future researchers using this scale to achieve more meaningful and/or practical results.

Second, my findings also indicated that the problem solving scores of the pediatric nurses and the LTC nurses were not significantly different. I had originally thought, as suggested by research [13, 16, 19], that because the pediatric nurses on average had a higher level of education compared to the LTC nurses that they would score higher on the problem solving scale. This was not the case. Further inquiry into the relationship between type of nursing educational program (e.g., problem based learning vs. traditional lecture style learning) and practicing nurses' reported problem solving ability and/or CRU would provide valuable information to future researchers. Additionally, future research that compares the problem solving abilities of other healthcare professionals to nurses would help us to understand where nurses are situated in the continuum of effective to ineffective problem solvers.

Third, my study contributed to the body of knowledge about determinants of research use in nursing. My results confirmed previous research which has identified that both individual [3, 20, 21] and contextual factors [4, 22-25] are predictors of research use. All of my regression analyses were significant, meaning that the individual and contextual variables I selected accounted for some of the variance in CRU. The main finding of my study was that problem solving was related to CRU (single item) in pediatric nurses after controlling for demographic, unit, individual and contextual variables. Thus, pediatric nurses with higher levels of self-perceived problem solving were more likely to use research in practice. However, I expected more variables to be significant predictors of CRU as suggested in the literature [3, 4, 20-26]. Additionally, the relatively small amount of explained variance in my four regression analyses suggests that in future studies, researchers should consider other variables in their analyses.

Contributions to Nursing Practice

The usefulness of my research findings to nursing practice is limited. The results of my study indicated that there is a small but significant relationship between problem solving and CRU (single item) in registered nurses. However, this result was not consistent with both measures of CRU; when measured as a 5-item scale, the relationship was no longer significant. Furthermore, problem solving was a significant predictor of CRU, but only in one of my regression analyses. The inconsistency of my results indicates that more research needs to be done in this area, as my results may not demonstrate the true relationship between problem solving and research use. Nor has this study demonstrated with any confidence that there is a persistent and important relationship between problem solving and CRU. Therefore, at this stage, it would be premature based on this study to recommend changes to educational curricula or practice standards. Once basic psychometric properties of the abbreviated problem solving scale are better established, future studies with experimental designs, that evaluate the effect of problem solving interventions on research use and other outcomes, should be conducted.

Contributions to Theory

The theoretical framework that I chose to use for my research study was a combination of the Diffusion of Innovations theory [27] and the Promoting Action on Research Implementation in Health Services (PARIHS) framework [28]. I used this theory and framework in order to provide a guiding model for my study and to substantiate my choice of variables used in the analyses.

Although my results were mixed, my study still contributed to theory, but in limited ways. My study demonstrated the advantage of using two theoretical frameworks in order to

approach and understand a research problem in a more complex way. By using two theoretical positions I was able to look at both individual and contextual elements known to affect research utilization. My results confirmed that both individual and contextual variables were predictors of research use. Therefore, in a general sense, my study findings supported my research model, the Diffusion of Innovations theory, and the PARIHS framework. However, due to the inconsistency of my results, my study did not make any specific contributions to further this theory and framework. Further work to confirm the relationship between problem solving and CRU is needed before we can fully understand any specific theoretical contributions.

Limitations

As in all research, there are limitations inherent in this research study.

1. This study used self-reported survey data, which has limitations such as the risk for recall and social desirability bias. It remains possible that nurses self-reported problem solving abilities are actually quite different from their actual problem solving abilities; the same is true for self-reported CRU. These differences could potentially threaten the validity of this study.
2. There was a difference in the sample size between my two groups of nurses. There were 160 LTC nurses and 766 pediatric acute-care nurses. Therefore, the sample size of LTC nurses was not optimal for the number of variables present in my regression models. Ideally, I should have had at least 260 (10 people for every variable) to reduce the amount of error in the analyses [29]. My study was limited to the original sample sizes because I was using secondary data.

3. The inconsistency of my results indicates that the CRU single item measure and the 5-item scale measure may not be measuring the same concept.
4. Even though the abbreviated problem solving inventory used in this study showed adequate reliability, it remains unknown whether using the original problem solving inventory instead would have yielded different results. The original problem solving inventory has undergone more rigorous testing in a variety of different populations [13].
5. While blocked regression analysis, using context/setting as an independent variable, is an appropriate method for dealing with nested data, a more rigorous statistical technique such as generalized estimating equations or structural equation modeling may have yielded different and/or more meaningful results.
6. The small amount of explained variance in my regression analyses suggests that there are still other variables that need to be considered. Furthermore, my study design did not permit the assessment of causal relationships.
7. Even though the sample of registered nurses that I used in my study came from a number of different hospitals and long-term care facilities, the sampling techniques originally used were not random. Therefore, the results of this study should not be generalized beyond the original sample.

Due to the several limitations listed above, my findings should be interpreted with caution.

Conclusion

It is known that, separately, effective problem solving and research use in practice lead to improved patient health outcomes. This thesis research project explored registered nurses' problem solving ability and CRU and the relationship between these concepts. Although my

results were unexpected and inconsistent, this study still provides some important preliminary insights into the relationship between problem solving and CRU and highlighted the need for further research in a number of different directions.

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Appendix A: Data Analysis Protocol

1. Create new variables:
    a. STUDY: TREC nurses will be coded with a 0 and TROPIC nurses coded with a 1
    b. LTC: long-term care nurses working in urban facilities will be coded with a 0 and nurses working in rural facilities will be coded with a 1
    c. PEDS: pediatric nurses working in medicine units will be coded with a 0, surgery units with a 1, and critical care with a 2
2. For all variables (including demographics) and all scale items in the TREC and TROPIC datasets, run measures of:
    a. Central tendency
    b. Variability
    c. Skewness
    d. Kurtosis
    e. Check for outliers
3. Complete sample size tables
4. Compare demographics:
    a. Use t –tests and ANOVA (two-tailed; alpha of 0.05) to determine if the nurses within the two studies (e.g. rural vs. urban; medicine vs. surgery vs. critical care) and between the two studies (TREC vs. TROPIC) were significantly different in any of the following areas: age, educational level, employment status, sex, and number of years worked. The Scheffe's post hoc test will be used to provide specific information on which means are significantly different from each other.
5. Complete demographic table
6. Run a within scale correlation analysis for PS and complete table
7. Run a Cronbach's alpha for the PS scale
8. Run a correlation analysis for the CRU scale and single item and complete table
9. Run a Cronbach's alpha of the CRU scale
10. Run an ICC(1) for the CRU single item and the CRU scale (mean)
    a. In the 32 pediatric units
    b. In the 36 nursing homes

Decision point: Once this preliminary work has been discussed with my committee, I will then move on to answering my research questions

Research Questions

Research question 1:

What is the relationship between perceptions of problem solving ability and self-reported conceptual research utilization in registered nurses working in acute-care pediatric settings?

1. Using the TROPIC data
2. Run correlation analyses (all Pearson correlation analyses will be two-tailed and have alpha set at 0.05) using:
    a. Total PS scale score and the single item CRU score
    b. Total PS scale score and the total CRU scale score
    c. Total PS scale score and each of the 5 CRU items in the CRU scale
    d. Each of the 10 problem solving items (individually) and the single item CRU score
    e. Each of the 10 problem solving items (individually) and the total CRU scale score
    f. Each of the 10 problem solving items (individually) and each of the 5 CRU items in the CRU scale

Research question 2:
What is the relationship between perceptions of problem solving ability and self-reported conceptual research utilization in registered nurses working in adult long-term care settings?

3. Using the TREC data
4. Run correlation analyses (all Pearson correlation analyses will be two-tailed and have alpha set at 0.05) using:
    a. Total PS scale score and the single item CRU score
    b. Total PS scale score and the total CRU scale score
    c. Total PS scale score and each of the 5 CRU items in the CRU scale
    d. Each of the 10 problem solving items (individually) and the single item CRU score
    e. Each of the 10 problem solving items (individually) and the total CRU scale score
    f. Each of the 10 problem solving items (individually) and each of the 5 CRU items in the CRU scale

5. Output: This will provide me with correlation tables

6. Next, I will run a correlation analysis of all the independent variables with the dependent variables and complete table

Decision point: After all of the above is completed, I will then present a summary of the above information (by using tables and text descriptions) to my committee/ supervisor before proceeding with the rest of my analysis (research questions 3 and 4). We will discuss the implications of the findings up to this point (For example, if there are any significant correlations)

Research question 3:
What is the difference between perceptions of problem solving ability and research utilization in registered nurses working in adult long-term care versus pediatric acute-care?

7. The results from the above analyses will be compared using t-tests (two-tailed; alpha set at 0.05) to determine if there are any significant differences between the pediatric acute-care and adult long-term care nurses:
    a. Compare the total PS scale scores
    b. Compare the 10 single-item PS scores
    c. Compare the single item CRU score
    d. Compare the total CRU scale
    e. Compare the 5 items in the CRU scale

Note: ANOVA (with Scheffe's post hoc test) will be used instead of t-tests, to compare each sub-speciality (e.g. medicine, surgery, and critical care; rural and urban) if deemed appropriate through discussion with my committee (after completing research questions 1 and 2).

Research question 4:
How do registered nurses' perceptions of their problem solving ability influence their self-reported conceptual research utilization?

8. If the above analyses indicate that there is a correlation between my variables of interest, then I will run a separate multiple linear regression (hierarchical) analyses, also referred to as a "blocked regression" for each setting (pediatrics and LTC) using CRU as the dependent variable (both the single item and the scale separately). Therefore, I will be running four blocked regression analyses.

Block Number	Independent Variables
Block 1	problem solving
Block 2	age, educational level, employment status, sex, number of years worked, nursing specialty (or Urban/Rural facility)
Block 3	attitude, belief suspension, burnout, job satisfaction
Block 4	culture, evaluation, leadership, organizational slack, resources (electronic and structural), formal interactions, informal interactions

Decision point: Once I have completed the above analysis, I will combine the results into tables and text descriptions, and discuss the results with my committee members. At this point we will determine if further analysis is required, the implications and meaning of the results, and my next steps in the research process (i.e. if any changes need to be made).