Problem Solving by Public Health Nurses: Examining the Differences Between Novices and Experts

Eileen Sarsfield, PhD, PHCNS-BC
Marymount University
Arlington, VA
Presenter Disclosures

Eileen Sarsfield, PhD, PHCNS-BC

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No relationships to disclose

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Objectives

- Describe problem solving as a vehicle in examining expertise in public health nursing (PHN).
- Describe the differences in cognitive processes between novice and expert public health nurses as they solved ill structured problems typically found in practice.
- Discuss the study’s major findings and their implication for practice across diverse populations and settings.
Background

- Public health nurses are dealing with increasingly complex problems with fewer resources and manpower.
- Recent changes in the US geopolitical, technological, and demographic landscape have increased the need for PHNs that have the skills and knowledge to solve complex problems.
- Being skilled in problem solving is one of the core competencies of public health nursing (Quad Council, 2003).
Expertise in Hospital Nursing

• Most research regarding clinical reasoning, problem solving and expertise has been in hospital settings (Benner, 1984; Fleming & Mattingly, 2000; Fonteyn & Ritter, 2000; Simmons, Lanuza, Fonteyn, Hicks, & Holm, 2003; Taylor, 1997).

• Research from studies of hospital-based nurses cannot be generalized to inform public health nursing because of the sharp contrast between community-based and hospital-based nursing.
Expertise in Public Health Nursing

• The few studies examining expertise in public/community health nursing used interpretative phenomenology, qualitative/humanistic approach (Diekemper et al. (1999), SmithBattle et al. (2004), Langley (1997), McMurray (1992), and Eckhart (1988)).

• These studies expanded nursing’s knowledge and reported results that describe the characteristics of expert public health nurses, expert behavior, the development of population focused practice, and factors that contribute to expertise.
Problem Solving: The Differences Between Novices and Experts

- This study examined novice and expert PHN through a different lens.
- It identified differences between novice and expert PHNs in how they represented problems, solved problems and evaluated their solutions as they solved 2 complex problems found in public health practice.
- Additionally, the study featured quantitative analysis supported by qualitative data.
Problem Solving and Expertise

- Problem solving is one of the primary approaches in examining the differences between novices and experts.
- Many definitions of what a problem is: A main one is that:
- Problems arise when an individual, group or organization has a goal which is not being attained. Voss and Post (1988)
Types of Problems

Continuum

Well defined                                   Ill structured

Some problems become well defined in the process of problem solving.

Reitman, 1965
Well- Defined

- Have completely specified initial conditions and goals
- Have a known solution
- Use well known rules/concepts to solve
- Possess correct, convergent solutions
- Have few if any open constraints
- Have specified well defined “operators”
- Examples: Starting an IV; Changing a wound dressing; Performing nursing protocols

Reitman, 1965 Jonassen, 1997
Ill-Structured Problems (ISP)

- ISP have vaguely defined or unclear goals and open or unstated constraints
- ISP have divergent solutions or sometime no solution at all
- ISP have numerous constraints or limitations e.g.
- There is fundamental disagreement among the “community of solvers” about the constraints, actions and solutions. Reitman, 1965
- Solving ISPs requires good “metacognitive strategies” (planning, justification, negotiating and outcome analysis). Shin, Jonassen, McGee, 2003
Ill-Structured Problems (ISP)

• Most public health problems are ill-structured problems (ISP).
• ISP are solved differently than well-defined problems.
• Examples of ISPs in public health:
  Decreasing bullying in schools
  Increasing the rate of HPV vaccination
  Providing health care for undocumented immigrants
Information Processing Model of Problem Solving

- Problem representation stage
- Problem solving stage  
  Newell & Simon, 1972
- Planning and evaluation of solution stage

This last stage has been found to be an important component in solving ISP  
Voss, Greene et al. (1983)
Solving Ill Structured Problems

ISPs are solved differently than well-defined problems: Research has found that experts-------

**Problem representation**
- Define the open constraints (barriers)
- Define the causal factors

**Problem solving stage**
- Use decomposition (the solver divides the problem into sub-problems)
- Use conversion (the solver converts the problem into one that is more easily analyzed/solved)

**Planning and evaluation of solution stage**
- Use planning/goal statements
- Tend to evaluate the solution while solving the problem
Research Question 1 and Hypothesis

1. What are the differences in the problem representations of novice and expert public health nurses as demonstrated by the number of open constraints that are defined and the frequency of the descriptions of causal factors that occur in the think aloud protocol?

• $H_0 \ 1$: The expert public health nurses will define more open constraints and describe more causal factors than the novice public health nurses in the think aloud protocol.
Research Question 2 and Hypothesis

2) What are the differences in the problem solving methods of novice and expert public health nurses as demonstrated by the frequency of decomposition and conversion that occurs in the think aloud protocol?

Ho 2: The expert public health nurses will use decomposition and conversion more than the novice public health nurses in the think aloud protocol.
Research Question 3 and Hypothesis

3) What are the differences in the solutions of novice and expert public health nurses as demonstrated by the frequency of the planning statements (goals) and the number of evaluative statements that occur in the think aloud protocol?

Ho 3: The expert public health nurses will use more planning statements (goals) and evaluative statements in the think aloud protocol.
Design and Sample

- Descriptive /exploratory small group design.
- The purposive sample consisted of twelve registered nurses:
  - Six (novices) were graduate students enrolled in a public health(MSN/MPH) nursing program
  - Six (experts) were at least masters’ prepared nurses with a minimum of ten years of public health practice.
- The sample size was consistent with other research using protocol analysis.
Methodology

The study had two independent variables: level of expertise (novice and expert) and the problem statements (two) and initially 6 dependent variables: open constraints, causal factors, decomposition, conversion, planning/goal and evaluative statements.

9 dependent variables, which emerged from these study data and pertinent research, were added to the study after the pilot and two novice protocols were analyzed. (Total number of DV=15)
Protocol Analysis or “Think Aloud”

- This is a qualitative methodology for eliciting and analyzing verbal reports of cognitive processes (Ericsson & Simon, 1999).
- Protocol analysis assumes the following:
  1) We have short term and long term memory
  2) Recently acquired information in short term memory is directly accessible through verbal reports.
  3) People can be instructed to verbalize their thoughts or “think aloud” (TA) when solving the problem without changing the sequence and content of cognitive processes.
  4) Verbalizations can provide information about and reflect cognitive processes used during problem solving.

(Dunbar, 1998; Ericsson & Simon, 1999; Newell & Simon, 1972; van Someren et al., 1994).
Procedures

• Differences among experts and novices’ problem solving were identified by analyzing concurrent verbal reports of research participants who were instructed to “think aloud” (TA) as they solved the two ill-structured public health problems.

• One problem scenario addressed preventing and decreasing underage drinking, while the second problem scenario focused on preventing and decreasing obesity.
Analyzing “Think Aloud” Data

- The qualitative analysis occurred in three stages: guided by the process recommended by Ericsson and Simon (1999) and other research utilizing protocol analysis:
  1) **Segmentation of the data**: The data were segmented into broken, short lines or phrases that corresponded to pauses, intonations and other syntactical markers, such as “um”.
  2) **Development of the coding categories**: Based on themes that arose from the data (9), the information processing model, and from research (6)
  3) **Transcript analysis**: The transcripts were coded line by line based on the coding categories.
## Category Coding Scheme

<table>
<thead>
<tr>
<th>Problem Solving Phase</th>
<th>Coding Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem Representation</td>
<td>States Reason (causal factor) * (SR)</td>
</tr>
<tr>
<td></td>
<td>States Knowledge-based Information (SKI)</td>
</tr>
<tr>
<td></td>
<td>States Inferences (SI)</td>
</tr>
<tr>
<td></td>
<td>Seeks Information (SINFO)</td>
</tr>
<tr>
<td></td>
<td>States Constraints* (SCONS)</td>
</tr>
<tr>
<td>Problem Solving Methods</td>
<td>Decomposition* (DEC)</td>
</tr>
<tr>
<td></td>
<td>Conversion* (CONV)</td>
</tr>
<tr>
<td></td>
<td>Comparison (COMP)</td>
</tr>
<tr>
<td>Planning and Evaluation of Solution</td>
<td>Planning/Goal Statements* (PGS)</td>
</tr>
<tr>
<td></td>
<td>Evaluation Statements* (ES)</td>
</tr>
<tr>
<td></td>
<td>Summarizes (S)</td>
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</tbody>
</table>
Data Analysis

• After the transcript was coded, the number of segments of each code were summed and then divided by the total number of segments in the transcript to yield a proportion of the transcript that the code represented.

• For example, the transcript of participant 01, problem #2, had a total of 94 segments; there were 37 segments that were coded as Planning/Goal statements (P/GS); thus PGS comprised 37/94 or .393 of the protocol.

• This procedure was followed for all 24 protocols.
Quantitative Analysis

• The Hotelling $T^2$, a multivariate analysis of variance (MANOVA), tested whether the population means for the six dependent research variables and the additional nine variables were the same for the novice and expert groups and thus if there were significant differences (significance level $\alpha$) between novices and expert PHNs as they problem solved.

• A correlation matrix (Pearson’s $r$) was used to analyze the relationship between the variables.
Major Findings in Problem Representation

- There were no differences in the extent to which novices and experts defined causal factors and open constraints to form problem representations.
- Novices sought more information than experts, while experts used declarative knowledge statements significantly more than the novices to form problem representations.
- Experts formed multi-level complex descriptions of causal factors and open constraints as opposed to the novices who provided superficial, singular level comments describing causal factors and constraints.
Major Findings in Problem Solving

• There was no difference in the extent to which novices and experts used decomposition and comparison although experts used conversion significantly more than the novices as a problem solving method. Experts used their extensive knowledge to convert ISP to ones they were familiar with to facilitate problem solving.
• Experts also described decomposition and comparison in richer, more detailed terms than the novices.
Expert Decomposition Schema - Problem 2

Causes of Obesity

- Surrounding Community Promotes
  - Stress
  - Boredom
- Parents Obese
  - Children eat at home
  - Not Nutritious Food
  - Early Childhood Obesity
Major Findings in Planning/Evaluation

- While there was no difference in the extent in which novices and experts used planning/goal statements and evaluative statements, experts did describe planning steps/goals and evaluation using more complex, richer detail than experts.
Major Findings

• Correlation data showed that experts have more highly developed schemas about public health nursing practice and have developed extensive, highly consistent patterns which facilitated solving ISP using a top-down approach.

• Novices solved backward, using inconsistent random problem solving representation, problem solving methods and solutions, and trial and error.
Limitations of the Study

- Some expert participants in this study had extensive experience with the issues contained in Problems 1 and 2. This experience allowed them to use automation in their problem solving.
- The criteria for novice and expert may have not been discrete enough.
- The lack of an organized, independent evaluation of the content and appropriateness of the plans and actions that the novices and experts offered as solutions to the ISP.
Implications- Academia

• Most teaching involves the discussion of well-defined text book problems.

• In the case of PH nursing, teachers could discuss differences between these two types of problems and develop appropriate teaching strategies to address these differences.
Implications - Academia

- For example, teaching strategies could include the development of case studies featuring ISP in public health with questions formulated to stimulate seminar discussion around the features of these problems and how they are different than well-defined problems.
Implications - Practice

- Those who make hiring decisions and employ public health nurses in practice should be cognizant of the problem solving skills of their employees.
- This study showed that expert PHNs can solve ISP based on previous patterns, their well defined integrated networks and extensive declarative knowledge.
- But novice PHNs, with limited declarative knowledge who must search randomly for appropriate solutions, will need more guidance in solving complex, unstructured problems.
Implications - Practice

- Novice PHNs would benefit from an orientation which includes a description of ISP in public health and the differences between public health practice and the practice areas driven by more standardized protocols.
- Assign an expert PHN to serve as a resource and mentor to the novice PHN.
- Incorporate team work into the orientation, providing the novice PHN with a support group to assist in solving ISP so common in public health nursing practice.