Diagnostic Reasoning among Second Year Nursing Students

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Abstract

This paper reports on a study investigating the relationship of nursing students' approaches to learning and processing of information, science content knowledge, ability in interpreting and organising clinical data (nursing assessment), logical reasoning ability with the accuracy and quality of the nursing diagnosis made in a simulated diagnostic reasoning task. 169 second year pre-service nursing students participated in the study. Results of path analyses indicated a set of pathways from surface approach through nursing assessment to low quality nursing diagnosis that reflected less competent diagnostic reasoning; and a second set from content knowledge through logical reasoning to higher quality nursing diagnosis that reflected more competent diagnostic reasoning. The implications of these findings for nurse education are discussed.

Diagnostic Reasoning Among Second Year Nursing Students

Recent research in nursing has suggested that an important dimension of professional nursing rests on the competence of nurses to diagnose nursing problems accurately. Diagnosing client problems is required daily and has been identified by nursing bodies as a critical component of nursing practice (Jones, 1988; Gordon, 1980). In this study a model of diagnostic reasoning in nursing is explored. The model incorporates five interrelated elements. The five elements are presumed to measure various behaviours and activities carried out by nurses in diagnostic reasoning. These include nursing diagnosis, logical reasoning, content knowledge, nursing assessment and nurses' approaches to information processing (see Table 1).

Nursing diagnosis. Nursing diagnosis as used in this paper refers to the label given to the patient's health problem. In nursing the term diagnosis is used in a broad context rather than in the narrow sense of identifying disease. Nursing diagnoses do not label medical entities such as disease processes that require surgery or prescription drugs. Nursing diagnoses refer to conditions or behaviours that are relevant to health management and can be helped or changed by nursing action. A nursing diagnosis helps nurses to communicate clear and concise information about the patient's current health state and provides a basis for patient care. The NANDA (North American Nurses' Association) classification of Nursing Diagnoses provides nurses with a list of 76 nursing diagnoses (Kim & Moritz, 1984). As a number of NANDA nursing diagnoses may be used to describe a variety of health problems for any one patient, the nursing diagnoses for any one patient may need to be organized according to some criteria. Often, for example, nursing diagnoses are organized according to the priority in nursing action. In this study the organization of nursing diagnoses was based on the potential systemic implication of the health problem.

Diagnostic reasoning. The process by which nurses arrive at a diagnosis is commonly referred to as diagnostic reasoning (Carnevali, Mitchell, Woods & Tanner, 1984; Jones, 1988; Thompson, Ryan & Kitzman, 1990). Diagnostic reasoning is a complex cognitive activity involving both hypothesis generation and a search for information to confirm or reject the hypothesis. A number of researchers have described the different processing procedures involved when nurses go about making a diagnosis (Carnevali, 1984; Gordon, 1980; Jones, 1988; Tanner, Padrick, Westfall & Putzier, 1987). Jones (1988) suggests that little of the base information needed to make a diagnosis is available when the nurse is initially faced with the patient. Information may need to be gathered from various sources such as patient records, interviews and the nurses' own observations. According to Tanner (1984) the information taken tends to form clusters of related information. In turn the clusters of information are used to generate diagnostic hypotheses (Carnevali, 1984, Jones, 1988).

Content knowledge. One important component of diagnostic reasoning is content knowledge (Balla et al, 1990, Bordage & Zacks, 1984; Carnevali, 1983; Patel & Groen, 1986). The content knowledge a nurse brings to the diagnostic task plays a critical role in determining how the problem will be interpreted and which items of clinical information will be attended to. Thus, reference to prior content knowledge is a prelude to decision making and may have an important influence on the proficiency of the diagnostic reasoning processes that take place (Balla et al; Benner, 1984; Bordage & Zac, 1984; Corcoran, 1986; Holden & Kilinger, 1988). Much of the research investigating the role of content knowledge in diagnostic reasoning has come from expert-novice comparisons (Benner, 1984; Pardue, 1987; Itano, 1989; Corcoran, 1986; Rohwer & Thomas 1989). Thompson and associates (1990) conclude that experts are selective in the content knowledge used, utilizing only that knowledge directly relevant to a solution, thus yielding simpler associations between new clinical data and known information. This suggests that the development of expertise results from a content knowledge that is efficiently stored in memory and structured into networks of information interconnected by rational links. According to Putnam (1987) it is this richly interconnected structure of knowledge that constitutes understanding and allows the individual to recognize a problem state as belonging to a particular category of knowledge. The expert nurse is able to access this network readily and rapidly decide which clinical information is important, which cues are significant, and how to integrate these findings to make an appropriate diagnosis (Holden & Kilinger, 1988; Benner, 1984).

Nursing assessment. It appears then, that content knowledge is important for proficient diagnostic reasoning and that such proficiency is also dependent on the efficient recognition of important clinical information. The recognition and recording of clinical information is generally referred to as a nursing assessment and requires the ability to gather, interpret and organize clinical information. Systematic clinical data gathering helps nurses to break down the diagnostic problem in smaller and more manageable clusters of information. In dealing with clusters of information more working memory space is released for the cognitive demands involved in accessing and applying content knowledge, thus facilitating greater understanding of the diagnostic problem at hand (Kagan, 1988). Thus the path towards solving the diagnostic problem becomes a process involving relatively simple pieces of information combined and restructured into larger units of information. It regularly involves modifying and strengthening one's knowledge of the presenting situation by systematically integrating new and known information (Jones, 1988).

Logical reasoning. This notion of diagnostic reasoning suggests that the building of connections between new and existing knowledge is an important fundamental mechanism underlying diagnostic reasoning processes. How efficiently nurses make the connections between new clinical information and the content knowledge they already possess may be related to their logical reasoning abilities. Nurses' ability to reason logically requires the use of content knowledge to explain and elaborate on patients' problems. These explanations may include physical, biological or psychological mechanisms underlying a particular diagnostic problem. Logical reasoning serves to develop ideas and suppositions about the structure of a diagnostic problem and yield a growing line of thought (Schmidt, 1983). Finally, logical reasoning helps nurses to provide a clear recapitulation of opinions, actual knowledge and ideas about the problem. Balla and associates (1990) have demonstrated a strong relationship between the structural complexity of reasoning among physicians and the accuracy of a medical diagnosis. In other words, their findings suggest that the efficient use of content knowledge for making a diagnosis is dependent not only on the amount of content knowledge a physician possesses but how coherently that knowledge has been structured in reasoning and how complex and rich in elaboration the knowledge structures are.

Approaches to information processing. The different ways nurses go about organizing, structuring and dealing with information in diagnostic reasoning may be related to individual differences in the processing of information. The different approaches to information processing have been studies by a number of researchers (Biggs, 1987a; Eizenberg, 1986; Moore & Telfer, 1990; Entwistle & Ramsden, 1983; Watkins, 1983). Following Speth and Brown (1988) this area of research may be categorized under the common label of approaches to learning. Generally, researchers using the approaches to learning paradigm agree that there are consistent ways learner approach cognitive tasks and these may be characterized by three general approaches: surface, deep and achieving. The precise terminology and nature of the approaches, however, will vary according to the measurement instrument used.

Each of the three approaches may be categorized by identifying the predominant factors that motivate learners to engage in a cognitive task and the strategy that logically flows from that motive (Newble & Entwistle, 1986). Biggs (1987a) proposed that students adopting a deep approach tend to be motivated by an interest in the subject material and processing tends to focus on understanding the material and how it related to previous knowledge. On the other hand learners adopting a surface approach tend to focus on reproducing strategies and motives are geared at minimally meeting task requirements. An achieving approach is based on the motivation to succeed, with strategies aimed at optimal management of time and work space. Surface, deep and achieving approaches are presumed to have important implications for diagnostic reasoning in nursing. The use of a deep approach may be highly consistent with the demands of complex diagnostic reasoning processes. Conversely, the habitual use of a surface approach may well leave the nurse less inclined to seek relationships between units of clinical information and hence less likely to generate the inferences necessary for higher quality nursing diagnoses.

Thus far five elements of diagnostic reasoning have been described: approaches to information processing, content knowledge, nursing assessment, logical reasoning and nursing diagnoses. The five elements can be placed in the context of a 3P model (Biggs & Telfer, 1987). The 3P model refers to presage, process and product factors. For the purpose of the current study presage factors refer to the nurse's predisposition towards the task as indicated by the nurse's approaches to information processing. Process factors include content knowledge, nursing assessment and logical reasoning. Product factors refer to the outcome of diagnostic reasoning, that is various nursing diagnoses (see Table 1). According to the 3P model, a relationship exists among presage, process and product factors. Presage factors are presumed to influence both processing factors and product factors. Process factors are presumed to influence product factors.

The main purpose of the present study was to examine the viability of the 3P model of diagnostic reasoning as it applies to a group of second year nursing students. Specifically the present study aimed to examine the direct and indirect influence of the presage variables on nursing diagnosis as well as the influence of the process variables on nursing diagnosis in the 3P model of diagnostic reasoning described above.

Method

Research Design

The Study Process Questionnaire (Biggs, 1987a) was used to measure subjects' approaches to learning and information processing. A measure of content knowledge was based on a 31-item multiple choice renal knowledge test.

To obtain measures of nursing assessment, logical reasoning and nursing diagnoses, a diagnostic reasoning task was developed for the study. The task involved presenting subjects with a 200-word vignette describing a patient with a clinical renal problem, Acute Poststreptococcal Glomerulonephritis (APSGN). The vignette provided a description of a 22-year-old man displaying symptoms such as coffee coloured urine and a reduced output of urine. The patient was lethargic, with slight oedema around his eyes and his pharyngeal mucosa was slightly red. On examination it was revealed that his vital signs were raised and his urinalysis revealed haematuria and proteinuria. Laboratory tests revealed raised electrolyte levels. A medical diagnosis of APSGN was provided after all clinical data were presented. Subjects were first asked to generate a nursing assessment for the patient described. Then they were required to list four important nursing diagnoses using the NANDA list of nursing diagnoses, and to select one of these as the major diagnosis. After that subjects were asked to explain the reasons for their choice of the major diagnosis.

To make an accurate nursing diagnosis, subjects had to know the structure of the kidneys and the function they serve in filtering the blood, excreting waste products and in regulating the concentrations of electrolytes in extracelluar fluid. Without an appropriate good science knowledge base subjects were unlikely to recognize the importance of symptoms such as reduced output of urine or recognize the potential dangers associated with a build up of toxins in the blood. This task therefore called on subjects to use their science knowledge and to attend to important information provided in the vignette in order to make accurate and higher quality nursing diagnoses. For example, having recognized that the patient had a reduced output of urine and increased levels of toxins in the blood, and knowing that renal disorder gives rise to alterations in the body's homeostasis, subjects should make connections between the two and deduce that the patient's decreased urinary output and increased levels of toxins may be related to kidney dysfunction. Subsequently, the effects of kidney dysfunction on other systems of the body should be inferred. The level of inference involved is hence reflected in the diagnosis nominated as the major diagnosis.

Thus, the naming of the nursing diagnoses provided an outcome measure and reflected how successfully diagnostic reasoning was carried out. The generation of the nursing assessment provided an indication of the subjects' ability to collect, interpret and organize clinical information (provided in the vignette) as a prelude to generating a diagnosis. The explanation for the choice of the major diagnosis provided an indication of the subject's logical reasoning ability, reflecting how and why information from various sources was brought together. The SOLO Taxonomy was used to assess the structural complexity of logical reasoning as reflected in the written explanation.

Subjects

Subjects for the study included 268 second-year Diploma of Health Science (Nursing) students at a University in NSW. Full data were available on 169 subjects. Only subjects with full data were included in the statistical analysis. Subjects were predominantly female (82%), ranging from 18 to 49 in age with a mean age of 21.

Materials

Study Process Questionnaire (SPQ) (Biggs, 1987b). The SPQ is a forty-two item questionnaire designed to elicit preferred approach to the processing of information and learning in tertiary students. The SPQ describes students in terms of a predisposition towards surface, deep or achieving approaches to learning. It is scored by summing the responses to the five point Likert items through which subjects rate their degree of agreement with each statement. A rating of 5 indicates high agreement, 1 low agreement (Biggs, 1987b). Summed deep and achieving scores may also yield a composite deep/achieving approach.

Renal Knowledge Test. The renal knowledge test was included as a measure of content knowledge relevant to the diagnostic reasoning task. The renal knowledge test included 31 multiple choice questions directly related to the renal system. The test required essentially detail information without any scope for interpretative analysis. It was part of an examination paper for a Science subject students were required to take. The reliability of the 31 items was calculated to be 0.72, using Kuder-Richardson formula 20 (KR-20) (Hopkins & Antes, 1985).

Diagnostic Reasoning Task. This was the task described in the "Research design" section and was used to provide measures of nursing assessment, logical reasoning and nursing diagnosis, as follows:

1. Nursing Assessment. A nurse academic specializing in the teaching of renal nursing provided an expert response for the task. The expert response contained 31 items, this was used as a scoring key. All student responses were scored on the presence of absence of each of the thirty-one items listed in the scoring key. Nursing assessment responses were then factor analyzed using principal components analysis with varimax rotation (CSS/PC, Statsoft, 1988). A five factor solution was identified (variance explained 62%): pathology tests, presenting circumstances, observations, urinalysis and headings. Items for these five factors were grouped to form five nursing assessment sub-scales.

2. Nursing diagnoses. The nurse expert described above also provided a list of acceptable nursing diagnoses for the simulation task which included three highly relevant diagnoses and three less relevant ones. All subjects' responses were scored according to this list. The one major nursing diagnosis named by each subject was scored as tissue perfusion, fluid volume excess, urinary elimination (the three highly relevant diagnoses), marginal diagnosis (less relevant diagnoses, including hyperthermia, nutrition, breathing, potential for

infection) and wrong diagnosis. Hence any one subject will score a "1" on one of these five variables and a "0" on the remaining four.

The nursing diagnoses identified by the expert response were rank ordered according to their systemic importance. For example, tissue perfusion was considered to be the most systemic and highest quality diagnosis as it subsumes the marginal diagnosis, urinary elimination and fluid volume excess and implicates other body systems. The marginal diagnoses were considered to be the least systemic and lowest quality diagnosis as they reflected largely detailed and less important clinical information. Then the list of four nursing diagnoses generated by each subject was scored for its accuracy (1 point for each acceptable diagnosis named, providing a total diagnosis measure) and its quality (a weighted score for each diagnosis named, depending on its quality, providing a measure of qualitative diagnosis).

In sum, seven nursing diagnosis measures were used in the statistical analysis for this study. In order of quality they included quality diagnosis, total diagnosis, tissue perfusion, fluid volume excess, urinary elimination, marginal diagnosis and wrong diagnosis.

3. Logical Reasoning. The SOLO taxonomy (Biggs & Collis, 1982) was used to measure the quality of logical reasoning as reflected in the subjects' detailed explanation for choice of the major diagnosis. The SOLO taxonomy yields a five point scale describing, in ascending order of quality, the structural complexity of the subjects' response. These include prestructural, unistructural, mulitstructural, relational, and extended abstract responses.

Procedures

The materials for the study were administered to 268 subjects in normal class time. The SPQ was administered by the researcher in Week Three of Semester 1. Then subjects took their renal knowledge test in Week 7 as part of their normal assessment for their Science subject. The diagnostic reasoning task was administered by the researcher in Week 12 of Semester 1.

Results

The results of the data analyses are presented in two parts. The first part reports on individual zero-order pairwise correlations. The second part reports on the interrelationships among all variables in the 3P model of diagnostic reasoning using path analytic techniques.

Pairwise correlations

The results of the zero-order pairwise correlations indicated two major sources of influence on the nursing diagnosis measures. These included logical reasoning and approaches to information processing (see Table 2).

Logical reasoning was positively correlated with higher quality diagnoses including total diagnosis ($r=0.17$, $p<.05$), qualitative diagnosis ($r=0.20$, $p<.01$) and tissue perfusion ($r=.0.18,p<.05$), indicating that subjects who engage in higher quality reasoning are likely to name a higher quality diagnosis as the major diagnosis. Logical reasoning was also negatively correlated with lower quality diagnoses including marginal diagnosis ($r=-0.38$, $p<.001$) and wrong diagnosis ($r=-0.19$, $p<.05$). No significant correlations were found between logical reasoning and approaches to information processing, nursing assessment sub-scales nor renal knowledge suggesting that logical reasoning by itself was related to the quality of the cognitive product, but not to the presage or other process variables in the model. No significant correlations were found between the nursing diagnosis measures and other process variables.

For the approaches to information processing, only surface approach was found to be significantly correlated to the diagnosis measures. Surface approach was negatively correlated with higher quality diagnoses including tissue perfusion ($r=-0.24$, $p<.01$) and fluid volume excess ($r=-0.18$, $p<.05$), indicating that subjects with a reported surface approach were less likely to make nursing diagnoses that required a greater inferencing. On the other hand, surface approach was positively correlated with lower quality diagnosis including marginal diagnosis ($r=0.17$, $p<.05$). Deep, achieving and the composite deep/achieving approaches were significantly correlated with renal knowledge ($r=0.18$, $p<.05$; $r=0.17$, $p<.05$; $r=0.20$, $p<.05$, respectively), indicating that subjects with a reported deep, achieving or deep/achieving approach were likely to have more renal knowledge.

Path Analyses

The path analyses also revealed two significant combinations of elements leading to the nursing diagnosis measures. The first combination of elements included renal knowledge and logical reasoning, the second included approaches to information processing and nursing assessment sub-scales (see Figures 1 and 2). The amount of variance explained in each path model ranged from 5% to 20% (see Figures 1 and 2).

In the first instance a set of paths linked the approach measures to the nursing diagnosis measures both directly and indirectly through the mediating variables of nursing assessment sub-scales (see Figure 2). Surface approach emerged with the most distinct influence on the nursing diagnosis measures. Surface approach was directly and negatively linked with tissue perfusion (˛=-.20) and fluid volume excess (˛-.19), suggesting that subjects with a reported surface approach were unlikely to name a systemically higher quality diagnosis as being the major diagnosis. The positive path between surface approach and marginal diagnosis approached significance (˛=.13). The path between surface approach and urinary elimination through the Headings sub-scale also approached significance, indicating that subjects with a reported surface approach were unlikely to use headings in their nursing assessments and subsequently were likely to name the lower quality urinary elimination as the major diagnosis. Deep approach was directly and negatively linked to urinary elimination (˛=-.25), but achieving approach was directly and positively linked to urinary elimination (˛=.20). Both deep and achieving approaches also influenced the nursing diagnosis of tissue perfusion through the mediating variables of presenting circumstances and urinalysis sub-scales (see Figure 2).

In the second combination of elements, a set of paths revealed an indirect route from renal knowledge to the nursing diagnosis measures through the mediating variable of logical reasoning. Renal knowledge was positively linked to logical reasoning (˛=.15), which in turn was positively linked to total diagnosis (˛=.18) and qualitative diagnosis (˛=.21). The path between renal knowledge and tissue perfusion through logical reasoning also approached significance. These results suggest that subjects with more renal knowledge were likely to attain higher levels of logical reasoning and subsequently were more likely to diagnose at the systemic level. There was also an indirect (but negative) path from renal knowledge through logical reasoning to marginal diagnosis (˛=-.37) and wrong diagnosis (˛=-.20). This suggests that subjects with a high score on content knowledge were likely to attain higher levels of logical reasoning and were subsequently less likely to name a marginal diagnosis or wrong diagnosis as the major nursing diagnosis.

There was no direct link between renal knowledge and the nursing diagnosis measures indicating that content knowledge on its own was not sufficient to generate a nursing diagnosis.

Content knowledge only influenced diagnosis through logical reasoning.

A second set of path analyses was conducted using the composite deep/achieving approach measure instead of the separate deep and achieving approaches. This was done to avoid the statistical problem of the large shared variance between the two approach measures and to adopt the theoretical position espoused by Biggs (1987*a*). Results are depicted in Figures 3 and 4. In this analysis a clear path was found from the composite deep/achieving approach through renal knowledge and logical reasoning to the nursing diagnosis measures. This applied to total diagnosis, qualitative diagnosis, tissue perfusion, marginal diagnosis and wrong diagnosis.

Discussion

The purpose of the present study was to examine the viability of the 3P model of diagnostic reasoning as it applies to a group of second year nursing students. The direct and indirect influence of the presage variables on nursing diagnosis as well as the influence of process variables on nursing diagnosis in the model are discussed below in relation to the results of the study.

Direct and Indirect Influence of Presage Variables on Nursing Diagnosis

The results of the pairwise zero-order correlations indicated that for the presage variables only surface approach was related to the nursing diagnosis measures. Surface approach was positively correlated with marginal diagnosis, but negatively correlated with higher quality diagnoses including tissue perfusion and fluid volume excess. Deep and achieving approaches were correlated with renal knowledge. Achieving approach was correlated with nursing assessment sub-scales (including presenting circumstances and urinalysis). None of the presage variables were correlated with logical reasoning.

When all variables in the model were considered conjointly using path analytic techniques a similar pattern of results was evident. Presage variables were both directly and indirectly linked to the nursing diagnosis measures through two distinct routes. Direct and indirect positive paths linked surface approach with lower quality nursing diagnoses (including urinary elimination and marginal diagnosis), but negative paths linked surface approach with higher quality diagnoses (including tissue perfusion and fluid volume excess). The findings clearly indicate that nursing students with a reported surface approach were unlikely to generate high quality nursing diagnoses. On the other hand the composite deep/achieving approach was positively linked to higher quality diagnoses and negatively linked to lower quality diagnoses through content knowledge and logical reasoning. This indicates that nursing students with a composite deep/achieving approach and with greater content knowledge and higher levels of logical reasoning were likely to generate higher quality nursing diagnoses.

The Influence of Process Variables on Nursing Diagnosis

Process variables in the model included content knowledge, nursing assessment and logical reasoning. The results of the individual pairwise correlations indicated that both renal knowledge and nursing assessment sub-scales were not significantly correlated with any other process variables nor with any product variables in the model. Logical reasoning on its own was not significantly correlated with any other process variables, but was significantly correlated with product variables. Logical reasoning was positively related to higher quality diagnoses (including total diagnosis, qualitative diagnosis and tissue perfusion), but was negatively related with lower quality diagnoses (including marginal diagnoses and wrong diagnosis).

When considered in conjunction with all variables in the model using path analytic techniques, nursing diagnosis measures were indirectly influenced by renal knowledge through the mediating variable of logical reasoning. This applied positively to total diagnosis, qualitative diagnosis and tissue perfusion but negatively to marginal diagnosis and wrong diagnosis. Renal knowledge was not linked to any of the nursing assessment sub-scales suggesting that subjects tended to rely on their nursing knowledge rather than their content knowledge to interpret and organize clinical information. There was another indirect path from surface approach through nursing assessment sub-scales (including headings, presenting circumstances and urinalysis) to the nursing diagnosis measures (including tissue perfusion and urinary elimination). In this instance nursing assessment sub-scales acted to mediate the influence of presage variables on the two diagnosis measures.

The results discussed above indicate two separate kinds of pathways in explaining diagnostic reasoning in nursing. The first involves a path from a surface approach through nursing assessment to nursing diagnosis measures. This pathway clearly defines those student nurses who are less likely to generate accurate and higher quality nursing diagnoses. This is evident in the results for tissue perfusion, fluid volume excess and urinary elimination (see Figure 2). This path may well indicate a less competent profile of diagnostic reasoning. The second involves a path from the composite deep/achieving approach through renal knowledge and logical reasoning to the nursing diagnosis measures. It seems that student nurses with a reported deep/achieving approach who display higher levels of content knowledge and engage in higher levels of logical reasoning are more likely to generate more accurate and higher quality diagnoses and less likely to generate a marginal diagnosis or a wrong diagnosis. This pathway may well define the characteristics of more successful and more competent diagnostic reasoning in nursing.

Instructional Implications

One major finding in this study is that content knowledge alone is insufficient to influence the quality and accuracy of nursing diagnosis. This was consistent with the findings in Balla et al's (1990) study and compatible with Balla et al's notion that the learning of content knowledge and clinical work take place more or less independently of each other. Other researchers have taken a similar view and argued that although content knowledge is important it cannot be used to reason and solve problems before students have learnt to elaborate and examine interrelationships between new and known information (Balla et al, 1990; Benner, 1984; Bordage & Zacks, 1984; Resnick & Kolpfer, 1989; Rowher & Thomas, 1989; Tanner et al, 1987).

According to Collis (1989) learning and reasoning involve a number of different levels and that each level has its own integrity and its own use of information (Collis, 1989). This is consistent with the construct of Bloom's taxonomy indicating a hierarchy of levels of cognitive learning. Similarly, the SOLO taxonomy suggests that there may be different levels in the structure and complexity of thinking and reasoning. It also appears that learning and thinking can be organized in a hierarchial manner and that earlier levels may be subsumed into subsequent levels (Shuell, 1990). Therefore, each level serves to provide a building block for the next higher level. This suggests that higher levels of integrative thinking may be progressively built on lower levels of content knowledge.

Instruction to enhance student thinking and reasoning then, must focus on the learning of content knowledge and a concurrent attentional shift from the content knowledge to higher levels of meaning and integration (Kirby & Cantwell, 1985). Particular learning environments, such as problem solving learning, have been shown to facilitate the early interaction between content knowledge and higher level integrative thinking (Balla et al, 1990; Clarke, 1988; Newble & Clarke, 1986; Entwistle & Ramsden, 1983). With this theme in mind it is apparent that instructional procedures in specific nursing content areas must involve techniques that place content knowledge into the general schema of clinical problems. Thus knowledge acquired in the initial levels of learning may be extended by applying it to new situations. This may allow nurses to utilize more familiar concept driven information and thereby attach meaning to specific content information. Thus, initially isolated details can be brought together to form a more complex structure and understanding of a problem.

The use of the 3P model of diagnostic reasoning proposed in this study has provided a number of worthwhile insights into the processes used by nurses engaging in diagnostic reasoning. It seems that the use of the 3P model in nurse education may provide not only a useful method to examine the underlying diagnostic reasoning processes used by nurses but may also provide a number of important focal points for intervention.

Limitations of the Present Study and Suggestions for Future Research

The study, both through its limitations and its results, raises a number of questions for future research. One limitation of the study relates to the small amounts of variance explained by the proposed model. This needs to be taken into consideration when interpreting the findings of the study. The question also emerges as to how generalizeable the current findings are to other nurse populations and to clinical settings. As the subjects in the study were novice nurses with minimal amounts of clinical experience, the current findings may not generalize to expert nurse populations. Another limitation relates to the nature of the diagnostic reasoning task. For example, a more naturalistic exercise that required verbal responses may well have resulted in a greater commitment and motivation in doing the task. However, such techniques would require individual student interviews and given time constraints this may be difficult to achieve. However, the study could be extended to include a separate analysis using a small sub-sample of subjects employing the use of probing techniques or cued responses.

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Table 1.
3P Model of Diagnostic Reasoning in Nursing

Presage	Process level one	Process level two	Product
Approaches to Information Processing	Content Knowledge	Nursing Assessment Logical Reasoning	Nursing Diagnosis

Table 2.

Correlations Among all Variables in the 3P Model of Diagnostic

Reasoning Processes (N=168)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1.00																	
2	-26c	1.00																
3	02	51c	1.00															

4	-14	87c	87c	1.00														
5	05	-03	-03	-03	1.00													
6	-12	07	05	07	82c	1.00												
7	-24b	10	09	11	28b	60c	1.00											
8	-18a	11	-02	05	31c	51c	08	1.00										
9	08	-14	04	-06	53c	37c	-03	-14	1.00									
10	17a	-00	07	04	-01	-11	-20b	03	-13	1.00								
11	-07	-06	-08	-08	-50c	-42c	-17a	-10	-32c	-29c	1.00							
12	-13	12	12	14	10	10	14	-05	12	-15	-01	1.00						
13	01	05	23b	16a	-04	-04	-11	07	-06	07	08	17a	1.00					
14	-08	02	-04	-02	05	03	14	-06	-04	-13	-07	19a	26c	1.00				
15	-01	-04	16a	07	05	09	15	08	-09	-09	-01	14	29c	27c	1.00			
16	04	-03	09	04	06	08	05	06	01	-01	-02	09	25b	12	29c	1.00		
17	-08	18a	17a	20b	-07	-04	07	02	-09	-05	02	07	-06	-01	06	08	1.00	
18	-04	09	04	08	17a	20b	18a	01	09	-38c	-19a	06	-14	06	-02	10	15	1.00

Note: Decimals omitted.
a= p <.05 b = p <.01 c = p <.001

Variable Names

1 Surface Approach
2 Deep Approach
3 Achieving Approach
12 Headings
13 Presenting Circumstances
14 Observations

4 Deep/achieving	15 Urinalysis
	16 Pathology Tests
5 Total Diagnosis	
6 Qualitative Diagnosis	17 Renal Knowledge
7 Tissue Perfusion	18 Logical Reasoning
8 Fluid Volume Excess	
9 Urinary Elimination	
10 Marginal Diagnosis	
11 Wrong Diagnosis	